Concrete

Vol. 36 Chicago, June, 1930 No. 6

Selling Ready-Mixed Concrete in Erie

Charles H. Fry Mixing Plant Well Adapted to City of Medium Size—Avoid Having Too Much Equipment—Hire Extra Delivery Trucks in Rush Periods—Materials Heated in Cold Weather—Description of Plant Layout

WHEN the Charles H. Fry Construction Company four years ago considered placing ready-mixed concrete on the market in Erie, Pa., several adverse factors had to be weighed in the balance.

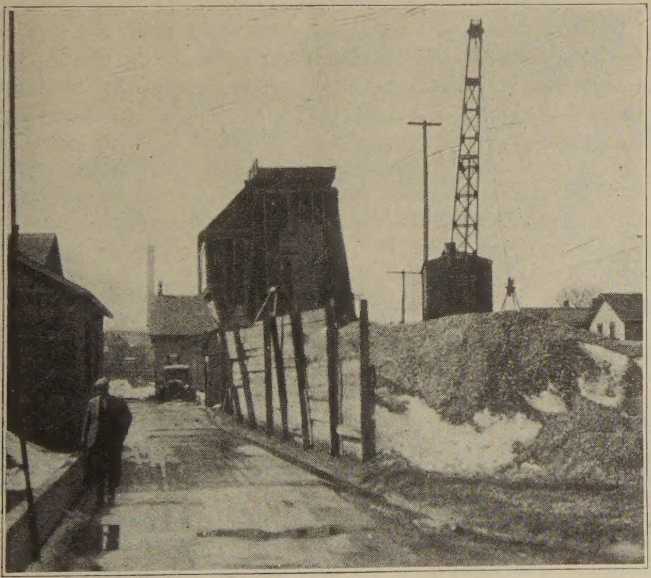
First of all, it was necessary to consider the usual opposition to a radical change, the unwillingness to do things in a way differing from the custom of many years.

The second adverse factor was that Erie, with a population of 125,000 or thereabouts, is not a large city. The value of new building construction work in Erie has averaged about $5,600,000 per year. Consequently it would be necessary to sell a much larger percentage of the total concrete used than in the case of a large metropolitan center.

Finally, the third factor that counted against the venture was that concrete work going into buildings in Erie had not been of the best, as a result of which the material was not in good repute.

Used Ready-Mixed Concrete in Own Work

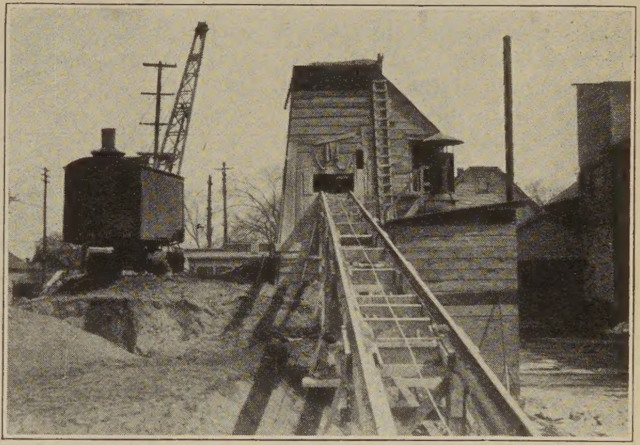
Against the three principal adverse factors was the knowledge that ready-mixed concrete of high quality could be delivered in proper condition from a central mixing plant. The Charles H. Fry Construction Company was then, and is now, engaged in the construction of street and highway pavements, and they had been delivering concrete to their paving work in ready-mixed form. Hence in offering this product to other contractors they had a convincing talking point in the fact that they were using the material themselves.



General view of plant, showing concrete drive, the mixing plant in the center of the picture, cement warehouse to the rear, and aggregate stock piles and crane on right

Plant Well Located

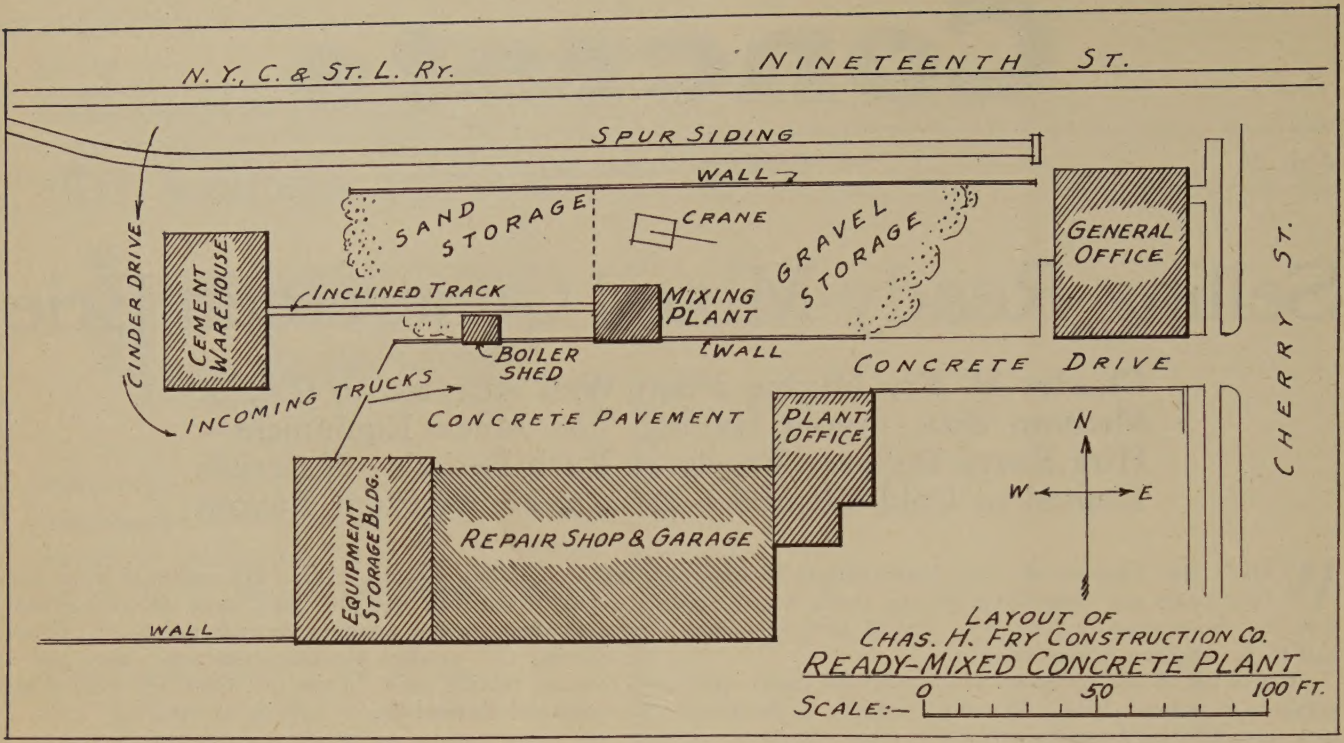
The Fry plant is well located with respect to receipt of materials and delivery of mixed concrete. It is alongside the Nickel Plate Railway, at the southwest corner of Cherry and Nineteenth Streets, close in toward the main business section of the city. A railway spur siding serves this plant exclusively. Cherry street is well paved, and the plant itself has a concrete paved driveway. Washed sand and gravel are bought from a pit near Fairview, Pa., also on the Nickel Plate, about 12 miles away.



A small car holding enough cement for one batch is drawn up this incline from the cement warehouse to the mixer. The crane on the left unloads gravel and sand from cars to stock pile and from stock pile to storage bins

Size and Arrangement of Plant

The layout of the plant is shown in one of the illustrations. In studying this layout the reader should of course keep in mind that the company carries on a paving contracting business as well as a ready-mixed concrete business, and that facilities such as office space, repair shop space and equipment storage space are larger than would be required for the latter business alone.



Layout of ready-mixed concrete plant of the Charles H. Fry Construction Co., Erie, Pa.

How Material Is Handled

As will be seen from the layout, cement is stored in a building and aggregates are in open-air stock piles.

Cement is received by rail, in sacks. When a car of cement is spotted opposite the storage house, portable conveyors are placed in tandem from the car into the building, the conveyors being supported on wooden frames, or "horses." These conveyors carry the sacks of cement to almost any point in the building. The sacks are stacked up in convenient piles on the main floor, while the empty sacks are piled on the upper floor of this 1½-story wood frame building. The cement is conveyed in bulk to the mixer, as and when required, in a small car that carries enough for one charge of the mixer. This small car is drawn up an inclined track by means of a windlass operated by the man at the mixer, after which it returns to the storage house by gravity.

Gravel and sand are unloaded from cars to stock piles and from stock piles to bins, by a self-propelling crane equipped with a clamshell bucket. Coal is used as fuel for the crane.

The Mixing Plant; Capacity

The mixing plant itself was designed by engineers in the Fry organization, fabricated by a local shop, and erected by the Fry company. The plant is inclosed and roofed over, except the sand and gravel bins at the top. These bins have a combined capacity of 18 cu. yd.

The mixer is a Ransome type, of 1-yd. capacity. It is charged by gravity from the sand and gravel bins above, the proportions being made by measure. Cement for one charge at a time is brought in bulk from the cement storage house in the manner previously described. The quantity of water is measured, and is adjusted by the mixer operator by a hand control. The mixing plant is driven by electric power.

The normal capacity of the mixing plant may be considered 150 cu. yd. per 10-hour day, but a daily production of 175 cu. yd. has often been attained.

Delivery Truck Equipment

Prior to the recent purchase of two transit-mixers of 1½ cu. yd. capacity, the regular delivery truck equipment consisted of three 1-yd. flat-bottom dump trucks. It is often necessary, of course, to hire additional trucks and drivers, whenever the demand is heavy. The management feels that this practice of hiring extra trucks and drivers to meet heavy demands is more economical than buying additional trucks, some of which would stand idle much of the time. The three trucks mentioned were sufficient to take care of the normal day-to-day demand.

Grades of Concrete Supplied

This company still adheres to the classification of mixtures by proportions, in its dealings with the trade, although care is taken that the water-cement ratio is held down to values consistent with the various proportions. The grades of concrete supplied include a 1:3:6 mixture for footings and foundations in small buildings, 1:3:4 for sidewalks and floors, 1:2:4 for heavy foundation work and structural concrete work in general, and 1:1½:3 for heavily reinforced concrete work. The 1:3:4 mixture for sidewalks and floors is in greater demand than any other grade. Topping for floors is also supplied.

How Deliveries Are Made

Orders are usually received over the telephone, at which time the person taking the order makes a note of the time at which delivery is desired, and assures himself that the purchaser will be ready to receive the material.

When the truck is loaded at the mixer the driver proceeds at once to the point of delivery. On large projects where a distributing tower is used the ready-mixed concrete is dumped directly into the conveying hopper at the base of the tower, or into a chute leading to the hopper. Likewise, on smaller work the concrete is dumped directly into place when possible, but more usually into a chute that conveys it into place, or into a hopper from which distribution is made in the usual way with buggies or wheelbarrows. Chutes for receiving concrete from a truck must be widened out at the truck end.

When the empty truck is returned to the plant the driver cleans it with a water hose under city water pressure.

Length of Haul

On the Fry company's own road construction work, concrete has been delivered from this plant for distances up to 16 miles, requiring about 50 minutes in time. It is seldom that concrete delivered in the city requires a haul of more than 3 miles, or more than 20 minutes in time.

Heating Materials During Cold Weather

Definite provision is made for heating the sand, gravel and water during cold weather. A small shanty, shown in the layout midway between the cement storage house and the mixing plant, contains a coal-fired boiler from which pipes convey hot water into coils in the sand and gravel piles, and into the mixing water. Live steam from the same boiler may be shot directly into the mixer.

With this heating equipment in operation warm concrete is delivered to the truck. The truck body is then covered with a tarpaulin and the material is delivered with but little loss of warmth.

Prices for Ready-Mixed Concrete

The base price for the concrete (the price at the plant) ranges from $7.25 per cu. yd. for the leanest mixture, to $9.25 for the richest. The price for topping is from $12.00 to $14.00 per cu. yd. at the plant.

Delivery charges are based on the length of haul. For convenience, the person who takes and makes out an order has before him a map of the city on which red circles are drawn one-half mile apart, with all circles centered at the mixing plant. The delivery charge for any point within the first circle (the first half mile) is 50 cents per cu. yd. For the zone between the first and second circles (from one-half to one mile) the charge is 65 cents per cu. yd. and for successively distant zones the charges are 75 cents, 85 cents, 95 cents and $1.05, respectively, the last figure being for distances from 2½ miles to 3 miles.

Close view of mixing plant, delivering a batch of concrete to a truck. The storage bins for sand and gravel are in the top of this structure

Repair Shop

The repair shop and garage are in a brick-and-steel building of the factory type, 50 by 101 ft. in plan. The repair and garage facilities are more elaborate than would be required for the concrete mixing equipment, inasmuch as repair service is given to all equipment used in the contracting end of the company's business.

Chutes are provided for delivering concrete to places inaccessible to the delivery truck. This picture was taken during a heavy snow flurry

The force required to operate the ready-mixed concrete part of the company's business includes a shop and plant superintendent, an office girl, a mixer operator, 3 truck drivers, and 1 crane operator (part time only, as required).

Tests of Quality

For the first two years of operation, tests of the concrete produced at this plant were made in Cleveland and Harrisburg. Since the city building inspection department established its own testing laboratory all strength tests have been made there. Without going into detail, it can be said that the strengths developed are consistently greater than required by the city building code.

Besides the sewer construction department of the city, the company has a large number of small contractors among its regular customers. Others include the Pennsylvania Railway Co., the street railway company, the National Foundry Co., the Standard Stoker Co. and many other industrial plants where concrete is required.

Special Sales Efforts

When the marketing of ready-mixed concrete was first undertaken, several salesmen were employed to help promote the use of the material.

At times salesmen have been employed since then; but in general not a great amount of sales effort has been required. In fact there is no sign in view at the plant to indicate that ready-mixed concrete is obtainable there.

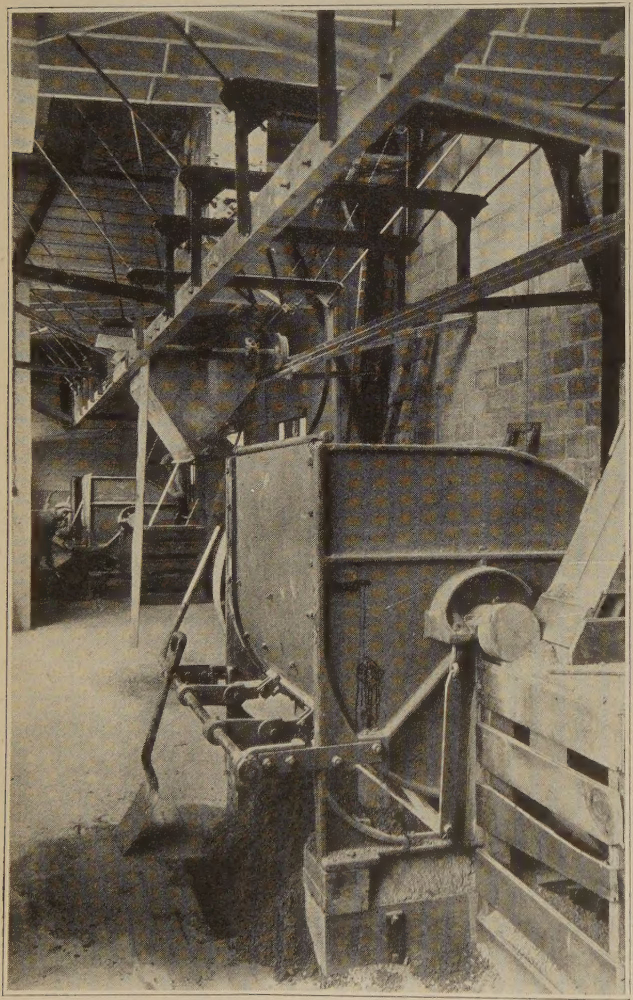
At the present time, with four years of experience passed by, little sales effort is required. Orders come in over the telephone from regular customers whenever concrete is needed. The pioneering stage has been passed and the business is on a well-established foundation.

Successful Piece-Work Pay System in Concrete Products Plant

Labor Costs Reduced and Stabilized—Increased Daily Production Per Man Brings Higher Pay—Quality of Product Improved—Schedule of Payment—Employees Approve System After Trial

By R. J. FISHER
Field Engineer, Wisconsin Concrete Products Assn.

THE piece-work method of paying men is not new in manufacturing generally. During the last few years several products manufacturers in Canada, as well as the United States, have tried it and met with varying degrees of success. There is, however, a wide variation in the systems used. More publicity to this phase of manufacturing should be of interest and help to the concrete products industry.



Mixer floor

Improvements and developments generally in the concrete products industry are hindered a great deal by the localized nature of the plants. The sales field is so limited and the conditions are so varied that continued co-operation among the manufacturers is very difficult to maintain. New methods and ideas developed by research laboratories and the more progressive plants may prove beneficial to some manufacturers and prove detrimental to similar plants under different conditions.

Help Themselves by Helping the Industry

It is only by closer co-operation on the part of each manufacturer that new ideas and developments can be brought about to meet present-day competition. Concrete products manufacturers owe a great deal to the interested parties who help promote the state and national concrete products conventions. It is at these meetings that the majority of new ideas are brought out and illustrated in such a way that all manufacturers have a clear conception of what it is all about.

The Wisconsin Concrete Products Association is one of the leading state associations today because its work has inspired confidence and has gradually removed the cloak of secrecy which in former years veiled most of the concrete products plants. It was through this idea of progress that permission was obtained from the Economy Concrete Products Company of Milwaukee to inform the entire industry as to the results obtained by the installation of the piece-work system of paying its labor.

Plans of Payment on Piece-Work Basis

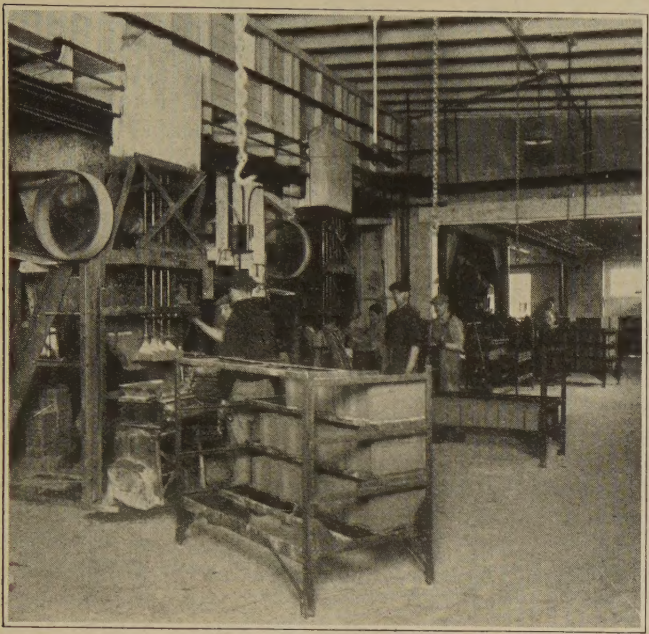
In general, there are three piece-work payment plans. One consists of paying the foreman for all labor. He hires and pays all help. Assume that the block manufacturer sets a labor cost of two cents per block for finished units piled in the yard. A plant with this system in operation would pay the entire amount to cover cost of labor.

This system has several obvious weaknesses. The foreman may hire cheap day help, in which case there is no incentive for the men to increase production. This invites danger of profiteering by the foreman, and the men are not apt to show any interest in the care of equipment. Furthermore, it does not offer any possibility for reduction of labor costs by the manufacturer.

A second system consists of a definite apportioning of the pay for labor among all the men. Assuming the same labor cost of two cents, the foreman and each man gets a definite percentage of this sum. If the men decide among themselves that a smaller crew can handle the work, the saving is apportioned among the remaining members of the crew, thus raising wages per man.

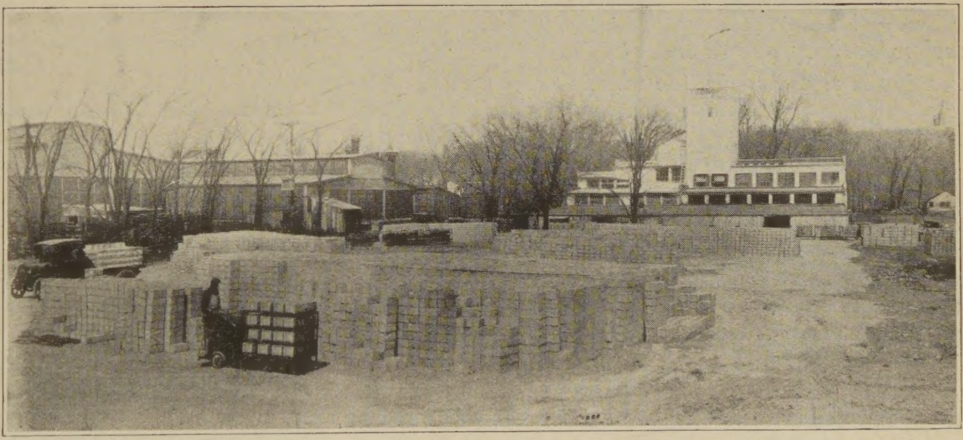
Some plants have a sliding scale which is merely a modification of this second system. The labor day for a fixed number of units for each machine each day is set at a definite figure. The total amount increases for each hundred units over this standard and decreases for each hundred units under.

The third system consists of paying the mixer operator, the machine operator and the off-bearers on a piece-work basis and hiring day labor for the curing rooms and stock piles. This system as applied to concrete products manufacture seems to have embodied all of the good qualities of the other two systems. It also seems to eliminate many of the objectionable faults.



Machine floor

In all three systems, an attempt at least is made to classify the work so that the amount that each individual workman receives is graded according to the skill required for performing his job.



Storage yard and plant of Economy Concrete Products Co., Milwaukee

Piece-Work Schedule at Economy Concrete Products Plant

The Economy Concrete Products Company, Milwaukee, Wisconsin, has adopted a system that would come under the third classification.

L. E. Schwalbe, president of the company, after investigating the use of piece-work, decided to adopt it at least for a thorough trial. Prices for each unit of work were determined and a set of rules and regulations adopted. These were presented to the employees in a letter in the form shown below.

PIECE-WORK SCHEDULE

Size Block	Machine Per Hour	Mixer Per Hour	Floor Man Per Hour	Yard Per Hour	Total Per Hour
4 in.	$0.60	$0.23	$0.12	$0.30	$1.25
5 in.	.60	.23	.12	.30	1.25
6 in.	.60	.23	.12	.30	1.25
8 in.	.65	.23	.12	.30	1.30
10 in.	.75	.23	.12	.30	1.40
12 in.	.95	.23	.12	.30	1.60
	Per 1,000	Per 1,000	Per 1,000	Per 1,000	Per 1,000
Brick	1.00	.10	.12	.30	1.52

If there is one man on the mixing floor, he will be paid at the rate of 18 cents per hundred.

If two men work on the mixing floor, the rate will be 23 cents per hundred.

If the machine operators place their own racks in the steam kilns, they will be paid at the rate of 10 cents per hundred for that additional work.

(1) The above prices call for perfect blocks. All low, cracked, or otherwise damaged block will be deducted at the rate of 6¼ cents per block.

(2) The yard men will be paid 25 cents per 100 blocks to set out all damaged block, subject to office or Schroeder's inspection.

(3) For other than piece-work, the hourly rate will remain as it is at present.

(4) The mixer man will be charged at the rate of 3 cents per block for slumped block—slump of ¼ in. or more.

(5) In case of breakdowns of less than one hour, no time will be allowed. For more than one hour the hourly rate will go into effect for the *operator* only. The off-bearer will go to some other machine.

(6) On machine changes which take an hour or more, the regular hourly rate now in effect will be paid.

(7) All cement will be unloaded at the rate of ¾ cents per bag.

(8) The floor man will be charged for damaged block while placing them in the steam kiln, at the same rate as the yard man.

(9) Men are subject to be changed about, according to the best judgment of the office.

Breaking the News to the Employees

When Mr. Schwalbe decided to install this new system he called his men together, handed them the above form and said, "Fellows, we are going to install the piece-work system. This form is going to stick. It has worked other places and we will make it work here. The superintendent has been given orders to fire any man that starts any fuss." The first two days there was a great deal of grumbling and threatening. Today there would be a great deal more trouble if the company tried to go back to the old system.

How the System Works in Practice

The results obtained by the new system are interesting. Although it has been in operation only a few weeks, it has yielded some decidedly interesting facts. This can best be shown by a comparison with previous costs.

Under the old system the production per man per ten-hour day for 8, 10, and 12 in. units averaged about 750, 725 and 500 units respectively. The new system averages so far about 1100, 1050, and 675, respectively. This big increase in production per man was brought about by using two men to the machine instead of the usual three.

The production for each machine is but slightly less, from about 2½ per cent for the 8 in. unit to about 10 per cent for the 12 in. unit.

Team-Work Brings Lower Cost and Bigger Pay

Increased efficiency through team-work on the part of the two men operating the machine is expected to increase production beyond that of the three men formerly attending each machine. The price of 60 to 95 cents a hundred for units from the 4 in. to the 12 in. size is enough incentive to bring production close to the maximum.

The system is too new to get a detailed report on costs, but taking the average of the 6, 8, 10 and 12 in. units, the cost has been reduced by four-tenths of a cent a block. The old production cost was 2 cents. Today it is 1.6 cents. A big saving is also made on low production days. Under the old system it was not uncommon for production to drop 20 to 25 per cent below the average daily production, causing a wide variation in the cost per unit. Under the new system the labor cost per unit remains the same regardless of the production.

A saving is also made in the unloading of cement. The price of ¾ cents per bag looks low, but so far it has netted the men an average of 83 cents per hour. A thousand-bag car is unloaded by nine men in a trifle less than one hour.

There is a saving around the plant that cannot be measured in dollars and cents, but it is a big saving. There is a great deal more contentment due to the higher wages. Where pay checks formerly ranged from $55 to $65 for a two-week period, they now run from $75 to $92. Quality of block has improved considerably and damaged block are a very rare sight.

The entire plant operation is much more efficient. Instead of the machine operator waiting for the lift truck to come back from taking away the loaded rack, he drags the empty rack in by hand and has everything ready to go when the off-bearer gets back. This was unheard of under the old system.

System Is Successful

In summing up it can be said that the new system so far has proved very successful. The main advantages are (1) fixed labor unit costs, (2) increased production per man, and (3) improved quality. A slight change has been suggested by Mr. Schwalbe, for the benefit of manufacturers who contemplate using the same system. To make the wages more consistent, it will be necessary to raise the scale for the yard men. This might be taken care of by a slight cut in the machine operators' scale.

Building Construction Contracts Continue Improvement

Continuation of the improvement in building construction first noted a month ago, maintenance of the large volume of contracts awarded for concrete highway pavements and for public utility construction, and an upward swing in contemplated construction, constitute the favorable side of construction news for April and early May. It is again necessary to report a continuation of the lag in city street paving work and in residential building.

Building Permit Values Increase

Building permit reports for the month of April received by S. W. Straus & Co. show a total of $210,411,881 in 584 cities. This is a gain of 12 per cent over March, whereas the normal trend for March to April is slightly downward.

The March figures, in turn, had shown more than the normal increase over the previous month. In the 25 leading cities April permits made a collective gain of 25 per cent over March.

Contracts for construction work for public utilities and public works departments reported by the F. W. Dodge Corporation were practically the same as in the corresponding month of 1929, but $44,320,100 greater than in March. The Dodge reports are:

Contracts Awarded in April

	1929	1930
Building	$489,933,600	$333,581,800
Public works and public utilities	152,126,900	149,669,900
Totals	$642,060,500	$483,251,700

Contracts Awarded in First 4 Months

	1929	1930
Buildings	$1,550,399,700	$1,127,489,100
Public works and public utilities	347,750,100	452,909,800
Totals	$1,898,149,800	$1,580,398,900

Contemplated construction reported by F. W. Dodge Corporation, after dropping off the previous month, again swung upward to a higher figure than a year ago. The totals are $954,617,400 for April, 1930, compared with $732,735,900 the previous month, and $940,249,100 in April, 1929.

Contracts for concrete highway pavements amounted to 14,337,642 sq. yds., compared with 12,315,070 sq. yds. in April, 1929, but concrete street and alley paving awards were slightly below the figures for a year ago. Because of this net gain in April, total pavements for the first four months of 1930 have increased the lead over 1929.

The comparison follows:

Square Yards of Concrete Pavements Awarded

	January 1 to May 4, 1929	January 1 to May 3, 1930
Roads	26,160,167	36,233,037
Streets	10,855,546	8,923,718
Alleys	699,780	593,909
Total Square Yards	37,715,493	45,750,664

Cements Shipments Are High

Cement shipments in April were 13,387,000 barrels, a big increase over the 8,846,000 barrels of the month before, and a slight increase over April, 1929, when shipments were 13,325,000 barrels.

How Concrete Is Tested on State Highway Work

Portable Testing Machine for Breaking Beam Specimens in Field—Ship Broken Specimens to Central Laboratory for Compression Tests—Average Test Results in Kansas—Use High Early Strength Cement for Closing Gaps in Pavements

By L. H. KOENITZER
Kansas State Agricultural College, Manhattan, Kansas

IT is common practice for highway departments to permit traffic on concrete pavements as soon as the concrete has gained sufficient strength, as shown by tests on beam specimens made on the paving job. This method has many advantages over the old rule-of-thumb method which required the pavement to be cured fourteen days and closed to traffic for 28 days. In many cases the concrete pavement gains sufficient strength to permit traffic going over it less than a week after it has been placed.

High Early Strength Cement for Paving Gaps

By using a high early strength cement it is only a matter of hours before the pavement has gained sufficient strength to withstand traffic. In one instance a short stretch of pavement had been omitted on a high fill. When the fill had settled it was necessary to pave the stretch, as the traffic on this particular highway was heavy. By using an early strength cement and making the proper number of test specimens it was found that the pavement had gained sufficient strength to permit traffic on the section less than 18 hours after the concrete had been placed.

Make Two Beam Specimens Each Working Day

It is common practice to make at least two beam specimens each day while concreting is in progress. The beams are molded in wooden forms made of 2-in. lumber. The inside dimensions of the forms are 6 by 6 by 35 in. The material for one beam is taken from a representative batch of concrete. Out of this same batch a slump test is usually run and quite often the weight of concrete per cubic foot is determined. The concrete is placed in the mold in 3-in. layers, each layer being tamped 150 times with a ⅝-in. rod with a bullet-pointed nose. Two cutting strokes are made on each side of the specimen with a brick trowel. The specimens receive the same curing during the first 18 hours as the pavement slab, after which they are transported to the plant inspector's laboratory, usually located near the weighing hoppers. The plant inspector removes the beam specimens from the molds, paints the identification numbers on them and places them in sand, which is kept wet. The molds are cleaned and oiled with ordinary form oil and returned to the grade inspector in time for one beam to be made in the forenoon.

Breaking the Test Specimens

Each beam is of sufficient length to permit the making of two breaks. Usually the first break is made when the specimen is four or seven days old and the second break is made at 10 or 14 days. Different state departments and local conditions vary the ages at which the specimens are tested.

Figure 1 shows a testing machine which has been perfected by the materials department of the Iowa state highway commission. Several other state highway departments employ these machines on each paving job in their jurisdiction. The machine is portable, enabling it to be moved from one paving job to another. It also fits into a small space, permitting it to be used in the average field inspector's laboratory.

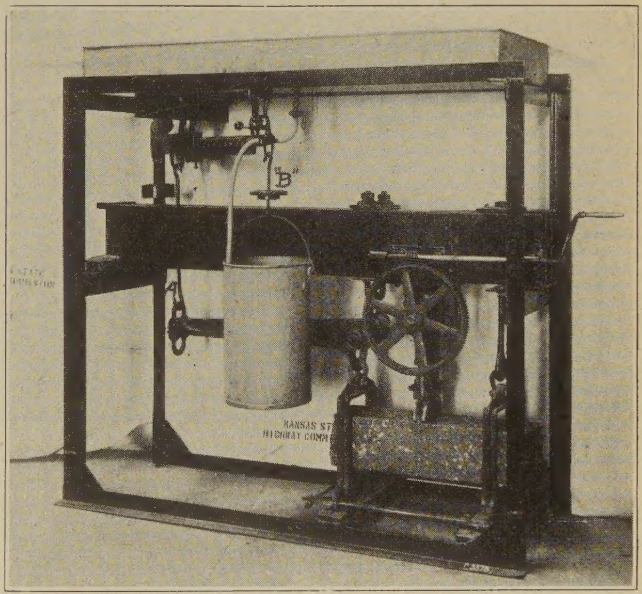


Figure 1. Field beam testing machine developed by Iowa state highway department

How the Testing Machine Operates

The method of applying the load and the general principle of the machine is simple and accurate. Fortunately there is nothing on it to get damaged or out of adjustment when being transported. The load is applied at a uniform rate of speed by turning a crank attached to a worm gear on the jack, applying the load on top of the beam midway between the two supports on which the beam rests. One principle of this machine approaches the ideal, in that the load is applied at a constant, uniform rate. This is accomplished by allowing water from the reservoir on top of the machine frame to flow through a rubber tube which passes underneath the scale beam into a bucket hooked on to the end of the scale beam. When the specimen breaks in flexure the scale beam automatically drops on the rubber hose, shutting off the water supply. The bucket containing the water is then removed and placed on the hook at "A." The scale weight is then placed on the hook at "B" and the counter poise moved on the scale beam until the load is balanced. The ratio of the levers are such that if the bucket and water weigh 20 lbs. the load as measured by one end reaction is 2,000 lbs., or 4,000 lbs. if both reactions are considered. By measuring the width and depth of the specimen to the closest 0.02 of an inch at the break, it is possible to determine the modulus of rupture either from tables already made up or from the flexure formula $S = \frac{MC}{I}$ where

S = modulus of rupture of the specimen,
M = the moment under the point of application of the load,
C = the distance from the center of the beam to the outer fiber,
I = the moment of inertia of the section.

Broken Specimens Shipped to Main Testing Laboratory for Further Tests

After the second break has been made on the beam specimen the portion with the square end is stored until a sufficient number are secured to send them by freight (uncrated) to the central testing laboratory. Several highway departments, including Iowa and Kansas, own a cut stone silicon carbide saw machine which they use in cutting the ends of the beam specimens square, thus permitting a compression test to be made on a portion of the specimen on which the flexure tests were made in the field. This information is valuable for a research study of mixes, curing conditions, and pavement design.

Saw Machine

Figure 2 illustrates the carbide saw machine. A 24-in. silicon carbide blade is run by a 30-horsepower electric motor having a speed of 1200 r.p.m. A small reversing electric motor moves the table back and forth at a constant speed.

The concrete specimens are clamped down as shown in the picture. Plaster-of-paris is put on the rough end to hold the pieces together while the ends are being cut. It is possible to cut 15 specimens at one time in about 20 minutes. The saw cuts a groove about one inch deep for each travel of the table. It is also possible to saw up slabs of concrete or sections of a pavement into specimens to be tested in flexure or compression for research work.

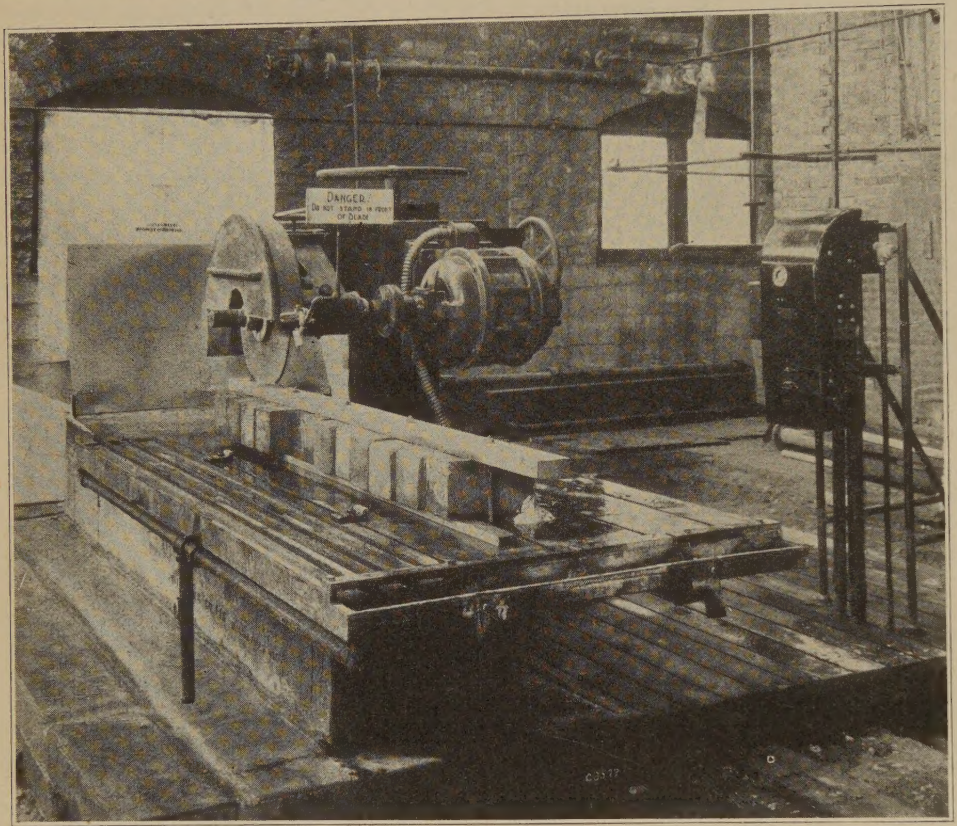


Figure 2. Silicon carbide saw for dressing broken concrete specimens for compression tests.

Results of Tests

The modulus of rupture varies, depending upon the kind of materials used (whether crushed stone or gravel aggregate), the weather conditions, curing conditions, and the condition of the specimens at the time of testing. It has been observed that specimens when tested dry are from 15 to 40 per cent weaker than those tested wet. This is directly contrary to the results obtained when the specimens are tested in compression.

Compression Average

The moduli of rupture for paving mixes vary from about 500 lbs. per sq. in. at four days to about 700 lbs. per sq. in. at 28 days. The compression on the beam ends averages about 4500 lbs. per sq. in. when tested at 90 days. The above values are the average of a large number of specimens and several paving mixes.

The Future of Concrete in Airports

Air Transportation in Laboratory Stage, but Developing Rapidly—Heavy Planes and Dense Traffic Make Concrete Only Choice for Runways—Vast Areas of Runways Needed—History of Automobiles and Concrete Roads to Be Repeated

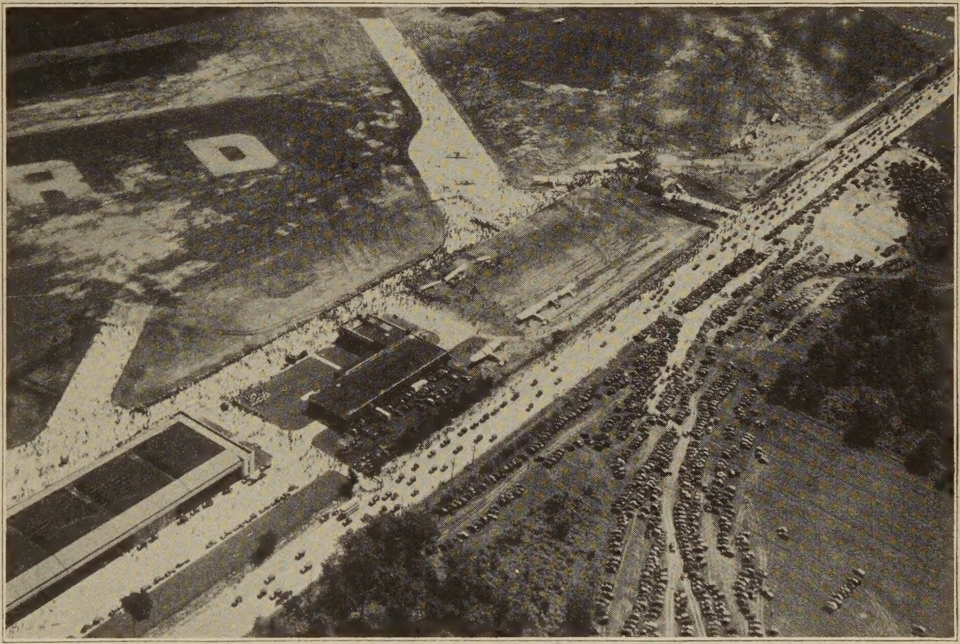
By J. E. BULLARD

THERE are indications that the future demand for concrete runways will call for as large a quantity of concrete as is now used in highway construction. Such a statement may seem extravagant in the face of the fact that very few concrete runways have yet been built.

A couple of years ago there was a good deal of sentiment in aviation circles against runways. It was held that a field covered with a good turf was preferable to one laid out with hard surfaced runways.

Now that a plane has actually been flown with a hundred passengers, it can no longer be maintained that it is impossible to build and operate planes with capacities of forty or more passengers. About the only argument now left against concrete runways is the cost. Therefore, it is well to consider this phase of the situation.

Hard surfaced runways are necessary for the safe and regular operation of large planes. They are not so necessary, though they are desirable, in the case of smaller planes. This means that the air transportation companies are the ones who will feel the need for concrete runways first.



Ford airport at Dearborn, Mich., gives hint of vast areas of concrete runway needed in airports of the present and future

Need for Runways Becomes Apparent

With the growth in the size of planes and in air transportation, this sentiment is rapidly changing. It has become obvious that if we are going to use planes having a capacity of forty or fifty passengers that hard surfaced runways become a necessity. The only way that such planes can operate daily over their routes is to provide hard runways upon which to land and take off. Even during the most favorable periods of the year a turf runway will not stand up under these planes. During the bad months of the year it is dangerous to try to land at a port that does not have hard surfaced runways.

Large Overhead Expenses of Transport Companies

At the present time the air transport companies are loaded down with a tremendous overhead and a relatively small volume of business. They are in very much the same position as a big railroad system would be if it kept its present organization but operated only one short train each way over the system every day. From eighty to ninety per cent of the total operating costs of the air transport company is in many cases on the ground.

Pilots fly but comparatively few hours a day, and the average annual mileage per year is extremely low. Organized to carry mail, the transport companies have not a schedule that attracts passenger business. If large planes are used and flown at closer intervals of time, there is likely to be so many accidents at the ports on account of improper landing conditions that the passenger business falls off.

In other words, the air transport business is yet practically in the laboratory stage. Most of the work being done is on an experimental scale rather than on a commercial scale. This is also true of plane and engine production. Airplane factories of today are pretty much in the same stage as automobile factories were thirty years ago. At that time the producing capacity of an automobile plant was such that in order to turn out as many cars as the present-day factory builds in a day, the plant would have to be kept going at full capacity for forty years!

Standardization and Quantity Production on Way

Standardization, simplification, larger production and increased efficiency all along the line are taking place. Engineers tell us that, given real quantity production, the present-day plane can be turned out and sold at a tenth of the present cost. An analysis of the data available about air transport operation indicates that with planes and engines produced on a real quantity basis, with larger planes being operated and with a plane an hour being operated in each direction over the routes, and business enough being secured to have these planes well loaded on each flight, rates can be cut to around a third or a fourth of the present rates and still allow the transport company to make more money. Just when that time will come, no one knows. However, it is known that the actual horsepower hours required per ton-mile in air transportation with the most efficient plane is less than required by land or sea transportation, even though the speed is so much higher. Cut down the cost of producing the equipment required, develop an engine which will use cheap fuel, operate the line so there is the minimum of idle time on the part of every employe and the maximum annual mileage per plane, and we cut down the cost of operation to a very marked degree.

Increased Business Means More Airports

Increase the frequency of flights over an airway, however, and you increase the need of hard surfaced runways and of more airports. Before aviation can become as important a factor in transportation as it promises to be, there will have to be between fifty and seventy thousand airports in this country. All the important airports will have to be paved with concrete runways. It will not be a case of a single runway in each direction. One runway cannot take care of the maximum traffic. It will be a case of many parallel runways.

Heavier Planes Make Concrete Runways Only Choice

The objection now presented that concrete is too expensive will be changed. With increasing congestion and larger and heavier planes, all other surfacing material will prove more expensive than concrete for a number of reasons. One of these reasons will be maintenance. When there was not more than an average of one or two planes landing at an airport a day and these planes were small and light in weight a turf field was entirely satisfactory. If the tail skid tore up the turf, the caretaker had plenty of time to make repairs before another plane landed or took off. When the planes grew larger and surfaced runways were needed, cinders, macadam or some other relatively cheap surfacing answered so long as there were few planes using the port and there was plenty of time to make repairs between the landing and taking off of planes. However, when we have so many planes landing every day that the capacity of the port is reached and the intervals between landing and taking off is steadily shortened, a runway surface that requires constant attention means that a much larger area of land must be provided if the port is to meet the traffic requirements. The maintenance of such runways will become very expensive because the planes will keep tearing up the surface. Something that will stand up with the minimum of maintenance then becomes essential. Because of the great increase in traffic the first cost will count for less than it does under the conditions that exist today.

Vast Areas of Concrete Runways Needed

There are indications that the air transport landing fields near the larger cities at least will need an area of about a square mile in order to take care of the traffic at these fields. About a third of this area, or around a third of a square mile, will have a concrete surface. In some cases it may be found desirable to have more of the surface concreted. In order that large planes may land any day in the year the smaller airports will need concrete runways. It cannot be a matter of such a great many years before there will be not less than 20,000 airports in this country, each with at least one concrete runway.

History to be Repeated

It must be remembered that three years ago a hard runway was not considered essential. A city that developed an airport with hard runways was inclined to make excuses for so doing. Today it is admitted that hard runways are necessary. Cheap surfaces are still being used. In a few more years there will be a greater and greater demand for concrete. It is exactly like the history of road building for the automobile. Today it is considered an economy to use concrete on highways where traffic is congested. The lower cost of maintenance and the decreased necessity of providing parallel routes so that roads can be closed for repairs more than makes up for the difference in first cost.

Development May Be Rapid

The development of air transportation promises to be very much more rapid than the development of motor transportation.

The real commercial use of motor vehicles dates from the war. The airplane, on the other hand, came to be used at first as an instrument of war. After the war it began to be used in a commercial way, but war planes were utilized to a very great degree. We have hardly yet developed a real commercial plane, yet commercial air transportation has become a business that is rapidly increasing. The general public has not yet taken in great numbers to flying its own planes. This, however, will undoubtedly take place soon.

In ten or twenty years conditions will be very different from what they are now. At any moment there may be a sudden increase in the demand for concrete runways. Once the public realizes that concrete airways mean safer landings and taking off, that they mean fewer accidents and practically eliminate fatalities at airports, it is going to demand that concrete runways be laid in airports from which they start and at which they arrive. It will prove more costly not to meet this demand of the public than to lay the concrete.

"Ready-Mixed" Starts Organizing

Well Formed Plans Get Under Way at Chicago Meeting —To Include Various Interests—Standardization, Protection and Independence the Goals

PRODUCERS of ready-mixed concrete representing an annual output of about 2,000,000 cu. yds. of concrete met at the LaSalle Hotel in Chicago on May 16th and voted unanimously in favor of taking immediate steps to organize the industry.

The Chicago meeting was called by the special committee recently appointed by the National Sand and Gravel Association,* this association having taken the initiative in the matter of organizing the ready-mixed concrete group.

Classifications of Producers

The producers of ready-mixed concrete who attended the meeting were about equally divided, in numbers, between companies that also produce sand and gravel and companies that do not. It was on this fact that considerable of the later discussion was based. As some of the delegates pointed out, the production of ready-mixed concrete has attracted men from several important groups. Among these are the following:

(1) Men who were formerly in some branch of the construction industry and are now devoting all their time to the production of ready-mixed concrete.

(2) Producers of sand and gravel, or of crushed stone, who are producing ready-mixed concrete as a side line, as a means of increasing the market for their main line.

(3) Building material dealers who are selling ready-mixed concrete as a means of expanding their market for concrete materials.

(4) Contractors, mainly in the paving field, who originally used centrally-mixed or truck-mixed concrete in their own work, and are now selling concrete to others.

(5) Producers of special aggregates, such as slag or haydite, who likewise entered the ready-mixed concrete field as a means of increasing their market for aggregates.

(6) In special cases, such as that of the Birmingham Slag Co., where ready-mixed concrete is marketed by a subsidiary organization to dispose of an industrial by-product.

No one pretends to know, even approximately, what percentage of all producers would fall under any one of the foregoing classifications. In fact, some would come under more than one classification.

Propose Separate Organization

Because of the wide range of present and former connections of producers of ready-mixed concrete, it was thought best to form a separate organization rather than to attempt to function as a department of an existing material association. All speakers who advocated a separate and independent organization were emphatic in declaring that they were in no sense unfriendly to the National Sand and Gravel Association. They fully appreciated the value of the service rendered by that organization, but felt that an independent association of the ready-mixed concrete group would give the organization more prestige and would be financially possible.

After an extended discussion, the delegates voted unanimously in favor of a separate organization, but in favor also of accepting the offer of the National Sand and Gravel Association to permit the use of their engineering, research and office facilities for the time being.

A temporary committee headed by R. B. Young, of Toronto, was appointed to prepare a tentative form of organization to be recommended to the industry. This committee's report, which was presented and adopted at the afternoon session, contained recommendations which are now to be sent out to all known producers in the United States and Canada in an effort to get a cross-section of opinion. The recommendations follow:

(1) The industry shall form an independent organization under the name of the National Ready-Mixed Concrete Association.

(2) The purpose of the association shall be to protect the members from destructive and unfair competition, to disseminate information of value to members, and to establish standard specifications and practice.

(3) Membership shall be confined to two classifications, namely, members and associate members. The first classification shall include producers of ready-mixed concrete for commercial purposes. Associate members shall include producers of materials for concrete, equipment manufacturers, and publishers of trade and technical journals.

(4) Acceptance is recommended of the offer of the National Sand and Gravel Association to permit use of that organization's engineering, research and office facilities so long as this arrangement is satisfactory to both parties. The National Ready-Mixed Concrete Association is to bear the cost of these facilities. Co-operation with all other interested associations will be cultivated.

Temporary Committee Appointed

A temporary executive committee was appointed to make a survey of the industry by submitting the foregoing recommendations to all producers of ready-mixed concrete, for criticism or approval. This same committee is to call a general meeting within 30 days, or as soon thereafter as possible, to present the results of the survey and to form a permanent organization.

The chairman of the temporary executive committee is Joseph E. Burke, manager of the Ready-Mixed Concrete Co., 27 Barbeau St., Pittsburgh. The other four members are A. C. Avril, of Avril Tru-Batch Company, Inc., Cincinnati, Alexander Foster, Jr., of the Warner Company, Philadelphia; C. M. Cornell, of the Boston Sand and Gravel Co.; and Arthur A. Levison, of the Blaw-Knox Co., Pittsburgh.

---

*See May, 1930, issue of CONCRETE, page 26.

Can Admixtures Be Standardized?

Cloyd M. Chapman Discusses Shortage of Conclusive Data—College and Commercial Laboratories and Other Agencies Can Supply Information Needed — Efforts Should Be Co-ordinated—Too Much "Ad" in Admixtures

At the request of the Editors of "Concrete," Cloyd M. Chapman, consulting engineer and chairman of A. S. T. M. Committee C-9 on Standard Specifications and Tests for Portland Cement, gives his opinion on the present situation respecting admixtures in concrete. Much data will be needed before intelligent conclusions can be drawn. Until the present deficiency of data is corrected, Mr. Chapman thinks, standardization can be established only to a limited extent; but under guidance that will insure co-ordination, college and commercial laboratories and other agencies can carry tests and investigations to the point where standard specifications can be written.—The Editors.

TO THE EDITOR:

I AM glad to comment, as you have requested, on the subject of admixtures for concrete. Let us start with a definition:

Admixture. In the case of concrete, any material, other than the usual essential ingredients, added to concrete for the purpose of altering one or more of its physical properties.

Under this definition falls a wide variety of material of varying degrees of efficacy. Claims of a most extravagant nature are made for materials of very doubtful value. In the January, 1929, issue of CONCRETE the Editor called for the standardization of admixtures under suitable specifications. If our present knowledge of the subject were sufficient to enable us to write adequate and reasonable specifications, they would no doubt be very acceptable and useful to many greatly perplexed engineers, architects and contractors.

In the present state of the art, there is insufficient information available upon which to base standard specifications. A few of the commonly used classes of admixtures might be subject to one standard specification. For example, calcium chloride, and the many trade name aliases under which it travels, can be specified as to purity, the quantity to be used, the method of mixing, etc., with some exactness. In fact, this has been done by many of the producers and larger users of this material. The same may be said of some other more or less definite materials, such as hydrated lime, for example—and there are others —but when we get into the field of finely divided or pulverized materials, of which no two are sufficiently similar to be covered by a single specification, the trouble starts and grows apace.

The great difficulty lies in the fact that our positive, conclusive, unassailable data on the effect of admixtures and their advantages are extremely limited, much too limited to form the basis of specifications.

This state of affairs should not and need not continue. The concrete industry, the makers and marketers of admixtures, the cement manufacturers, the aggregate producers, colleges and commercial laboratories, are able and probably willing, under suitable guidance to insure co-ordinated effort, to investigate this big subject of admixtures to such a point that specifications could be written. At least the research could be carried to a point where the sheep would be distinguishable from the goats and much of the present perplexity would vanish, probably only to be succeeded by a new batch of perplexities over a new batch of admixtures which would by then have appeared on the market.

Some very interesting things have been done with admixtures. There can be no doubt of the usefulness and value of some of them, but to read the extravagant claims in the "ads" of the producers brings one to the conclusion that there is too much "ad" in admixtures. Some of the most remarkable results which are attainable by the addition of materials not commonly used in concrete have not been broadcast to the general public. It is noticeable, as one goes about the country meeting men interested in concrete, how many of them tell of some past or present experience involving the use of some fourth ingredient—something besides cement, water and aggregate—in concrete and the remarkable results they obtained. These things should be verified, checked and double checked, and in the end this perplexing matter of admixtures would no longer be mysterious.

CLOYD M. CHAPMAN.

New York City, May 16, 1930.

~ New Book ~

Concrete Year Book

THE CONCRETE YEAR BOOK 1930. By Oscar Faber and H. L. Childe. Pages, 680. Published by Concrete Publications, Ltd., London, England.

The new edition of this reference work, for use as a handbook, directory and catalog of concrete, now in its seventh edition, has been further enlarged by forty pages.

The handbook section, comprised of 200 pages, contains much information for every-day use. Chapters are included giving tabulated designs of foundations, floors, walls, beams, columns and other building members to carry various loads, illustrated with diagrams. Other subjects dealt with include light-weight aggregate, cast stone, concrete making and placing, reservoirs, water towers, roads, sewers and culverts, etc.

~ EDITORIAL ~

Age Should Earn Respect for Water-Cement Ratio Law

MANY have the mistaken impression that the relation between the water-cement ratio and the strength of concrete is a new discovery that needs further trial before deserving acceptance.

It is true that general knowledge of the influence of the water-cement ratio and the practical application of this method of controlling the strength of concrete is a development that belongs to the last decade. It is only within that time that progress has been made toward establishing the relation in definite terms, so as to make the use of this method of quality control possible in every-day construction work.

Knowledge of the relation between the quantity of water and the strength, however, is older than portland cement. This relation is mentioned in Parker's Specification for Cement for Building Purposes, published in 1796 by James Parker, of Northfleet, County of Kent, and reproduced in "A Hundred Years of Portland Cement," by A. C. Davis. The following extracts are taken from Parker's Specification dated July 27th, 1796.

"To compose the cement in the best and most advantageous manner, I take two measures of water and five measures of the powder thus described; then I add the powder to the water, or the water to the powder, taking care to stir and beat them during the whole time of intermixture; the cement is then made, and will set or will become indurated in ten or twenty minutes after the operation has ceased, either in or out of water."

Later on in Parker's Specification are the statements that "no other proportions will produce so strong a cement in so short a time as those I have here pointed out" and "the less water is used the better."

Parker's cement, on which he took out a patent, was a natural cement made from an argillaceous stone, but was made by a process which was fundamentally the same as the process used today in the manufacture of both natural and portland cement. The users of Parker's cement must have been acquainted with this relation between the amount of water and the strength, and it is not improbable that Joseph Aspdin, who is credited with having invented portland cement in 1824, knew and understood the effect of the ratio between the quantity of water and the volume of cement.

Presumably the measure used by Parker for proportioning was the same for the water as for the cement. If this supposition is correct his proportion of two measures of water and five measures of cement was the equivalent of 3 modern U. S. gallons of water to a cubic foot (1 modern sack) of cement.

Odd Sizes of Bars Cost Money

THE working plans for an important reinforced concrete building recently submitted to bidders specified a number of odd sizes of bars—size differing from those included in the list of eleven standard sizes for reinforcing bars given in Simplified Practice Recommendation No. 26, a pamphlet issued by the Division of Simplified Practice of the United States Department of Commerce.

Distributors of reinforcing steel bars confine their stocks largely to the eleven standard sizes, which cover a wide range from ¼-inch round to 1¼-inch square. Non-standard sizes are considered special, and they cost more than the standard sizes. If the cost is not actually greater in cents per pound, it is greater because of the greater difficulty in getting non-standard sizes.

Simplified Practice Recommendation No. 26 may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., for the nominal sum of 5 cents. There is, consequently, little excuse for continuing the practice of specifying non-standard sizes on plans for structures of reinforced concrete.

Color in Concrete

THERE is little question that color has caught the interest and stimulated the imagination of architects who like to deal with concrete.

Progressive manufacturers of concrete masonry units some years ago turned to color as one means of adding life to walls of this material. Later, when monolithic concrete became recognized by leading architects as a medium for architectural expression, color was one of the factors in the problem. Without color monolithic concrete has a restricted use in architectural treatment; with color, the possibilities are all but unlimited.

Whether color is supplied by the addition of coloring matter to the cement, or whether it involves a staining or painting process after the concrete has hardened, the final result must be a color that will stand up against rain and sun.

Current Activities of Organized Groups

Many knotty problems pertaining to cement and concrete are either in course of solution or recently completed by organized societies or smaller groups. The busy reader may keep himself informed by watching these items.

Joint Committee Report on Concrete to Be Revised

THE JOINT committee on Concrete and Reinforced Concrete, which in 1924 issued the well known Standard Specifications for Concrete and Reinforced Concrete, is being reorganized.

The final reorganization meeting is to be held during the forthcoming annual meeting of the American Society for Testing Materials, after which the joint committee will undertake a complete review of the 1924 report.

When the 1924 report was published it represented what was then considered the best practice in the design and construction of concrete structures. Since that time many advances have been made in the art of making and using concrete, and valuable comments and criticisms have been received from engineers throughout the country.

In addition to this, the American Concrete Institute, one of the five organizations sponsoring the Joint Committee, used the 1924 report as the basis for its Tentative Building Regulations for Reinforced Concrete, first issued in 1925. Revisions were published in 1927 and 1928.

Besides the American Concrete Institute and the American Society for Testing Materials, other sponsoring societies are the American Railway Engineering Association, the American Society of Civil Engineers and the Portland Cement Association.

New A. S. T. M. Committee on Mortars

THE EXECUTIVE committee of the American Society for Testing Materials has decided to appoint a new standing committee on Mortars for Unit Masonry.

Members of the Society are requested to inform the secretary regarding studies of masonry mortars upon which they may be engaged, or about which they have knowledge. Names of members particularly qualified to serve on this new committee will also be welcomed.

Proposed Fire Prevention Ordinance

THE NATIONAL Board of Fire Underwriters has completed and published its general fire prevention ordinance prescribing regulations covering hazardous materials and processes. This ordinance contains the best features of those of a similar nature already adopted in Richmond, Va., Pittsburgh, Pa., and other cities and may be used as a guide by municipalities undertaking such legislation. The National Board will supply copies gratis to those who will address the nearest offices either at 85 John St., New York City, 22 West Adams St., Chicago, or Merchants Exchange Building, San Francisco.

Sizes of Removable Concrete Forms

STANDARD SIZES of removable and permanent concrete forms, pans or domes, made of wood, steel or other material ordinarily employed in concrete ribbed floor construction, are given in Simplified Practice Recommendation No. R87-29, issued by the Bureau of Standards of the United States Department of Commerce.

Copies may be obtained at 5 cents each by addressing the Superintendent of Documents, Government Printing Office, Washington, D. C.

Ready-Mixed Concrete Association Being Organized

ON MAY 16th the special committee appointed by the National Sand and Gravel Association to consider the matter of organizing producers of ready-mixed concrete, held a meeting in Chicago.

A plan for an independent organization was devised and a temporary executive committee was appointed to present the plan to all known producers of ready-mixed concrete, for criticism or approval. Another meeting is to be held in June. The chairman of the executive committee is Joseph E. Burke, manager of the Ready-Mixed Concrete Co., 27 Barbeau St., Pittsburgh, Pa.

Design of Flat Slabs Under Concentrated Loads

THE AMERICAN Railway Engineering Association report on "Girderless Flat Slab Structures for Railroad Locomotive Loadings," mentioned in this department in the April issue (page 26), is now available in printed form. It comprises the first four pages of an A. R. E. A. pamphlet entitled "Report of the Committee on Masonry," copies of which can be obtained at 50 cents each by addressing that organization at 59 East Van Buren Street, Chicago.

Report of Load Tests on Concrete-Encased Steel Beams

THE SPECIAL committee appointed by the Western Society of Engineers to conduct a series of load tests on floor construction of concrete-encased beams and girders presented its full report before a meeting of that society on May 12th. The report comprises 69 pages, and is published in the June issue of the Journal of the Western Society of Engineers, copies of which are available at 75 cents each.

Canadian Standard Specification for Concrete and Reinforced Concrete

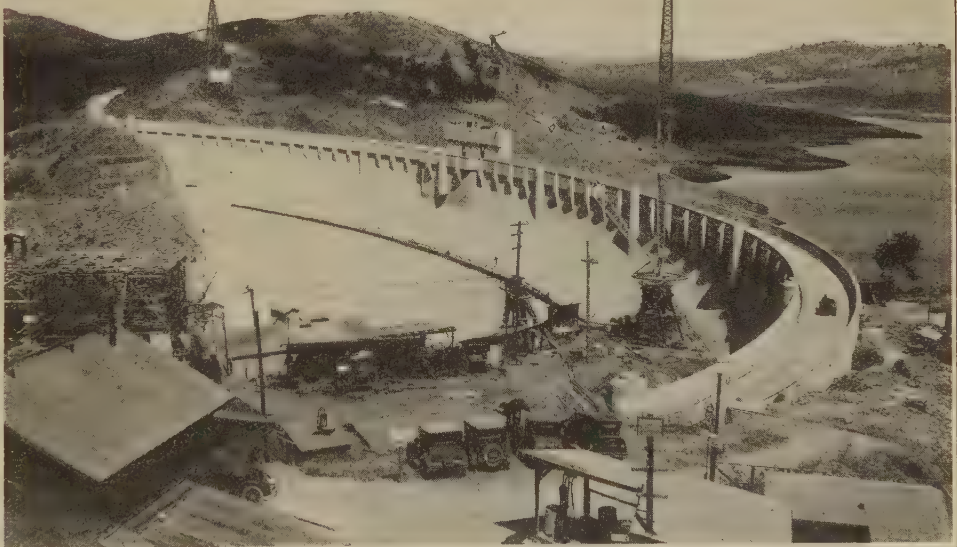
THE CANADIAN Engineering Standards Association (178 Queen Street, Ottawa, Canada) has issued its fourth yearbook, containing brief reviews of standards and reports completed or revised during 1929. Among the standards completed in 1929 is Standard Specification for Concrete and Reinforced Concrete (A23-1929).

New Pardee Dam a Triumph in Concrete Construction

Contractors Win Battle with Flood Waters—Build Flume to Take Flow of River—Construct 5-Mile Branch Railway to Bring Cement to Site, and 4-Mile Aerial Tramway to Transport Concrete Aggregates — Claim Record in Placing Concrete

By L. M. JORDAN

ABOUT the year 1925 there were nine of the East Bay cities of the Municipal Utility District of San Francisco, California, being faced with a serious need for a new water supply because they were threatened with a water famine. It was decided to build the new Pardee Dam, across the Mokelumne river near Valley Springs, Calif., to impound water for these nine cities. The construction of this dam, which is 358 ft. in maximum height, 241 ft. in greatest base width, and has a crest length of 1,337 feet, involved some very difficult problems, including as the worst a tremendous flood that swept down the canyon spanned by the dam as a result of melting snow from the Sierras. Despite this and other obstacles, by a grim determination of the contractors coupled with modern methods and devices, the work was completed in less than half the time allowed by the contract.



Construction work approaching completion in September, 1929

The contract for constructing the dam was drawn up and embodied extremely short time limits for its completion in order to avert the approaching water famine. The contract was signed by the contractors, the Atkinson Construction Company, in September, 1925, when orders were received to proceed with the construction in July, 1927. The contract called for the completion of the dam within 42 months. It was actually completed a year and a half ahead of schedule time.

Build Flume to Take Flow of River

The beginning of work consisted of the construction of a flume to take care of the river waters, and the work of excavation for the foundation was successfully conducted without interruption during the winters of 1927 and 1928, which made possible the completion of the work at least eight months earlier than if operations had been suspended for the winter periods. The river water had been diverted through the completed portion of the foundation, which extended more than half way across the canyon, when in March, 1928, a tremendous flood resulting from the melting ice and snow from the Sierras, rushed down the canyon at a volume rate of 40,000 cu. ft. of water per second, sweeping across the work. In this onslaught portions of the concrete and gravel plant and some steam shovels were carried away; but of the damage to the works the disruption of the cofferdams was the most serious. These were constructed above and below the dam across the river the previous October when water was low, by means of which to divert the stream through the sluiceways and flumes to make possible the working of the men between them and below the flume. This presented the most trying problem to the contractors, who were faced with the short time limits in the contract, and who had already sacrificed considerable of the men's stamina through eight months of winter exposure. Here again daring and courage and resourceful equipment won the fight against the waters and they were harnessed in less than a month and put back through the flume, which made possible the much earlier resumption of excavation and concrete work.

Build Railway to Transport Cement

The cement used in the project was transported to the dam site over a 5-mile branch line of railway that was built by the contractor. This was put up in cloth bags, the contents being dumped by hand onto an 18-in. conveyor belt that transferred it to the head of the concrete silo, where it was stored, 15,000 sacks at a charge, and to a depth of about 30 ft. Screw conveyors were employed to carry the cement to four 12-sack weighing batchers, one of which was positioned over each mixer hopper. It was weighed and deposited into the hopper simultaneously with the three sizes of aggregate.

Aerial Tramway Transports Aggregates Four Miles

Concrete aggregate material was secured from tailings of placer mining operations some 4 miles down the Mokelumne River. After gravel had been excavated by the use of a large dragline and transferred on cars to the base of the washing tower, it was elevated by means of a belt conveyor, after which it passed down through screens in the washing tower and was washed as it went. The gravel and large stones were simultaneously separated, the larger stones being diverted to the crusher. Aggregates were transported to the dam site from the gravel pit by means of the 4-mile overhead tramway. At the dam the aggregate was stored in large overhead bins.

Site of dam and view of foundation construction when overtopped by flood waters of Mokelumne river during season of melting snows

The value of modern equipment and methods was never appreciated in any greater degree than during the months of August and September, 1928, when the 18,700-ft. direct aerial tramway in use at this works transferred concrete to the dam at a rate in excess of 67,000 cu. yds. per month. The success of the program was attributable in a great measure to this tramway. It has been designed for 440,000 lbs. capacity of gravel, or 147 buckets per hour. It is reported to have transferred during the 79-day period intervening the dates of August 1 to October 19 some 232,800 buckets of material from the washing plant to the bunkers of the dam site, operating 235 shifts.

Mixing and Distribution of Concrete

Four electrically-driven drum mixers were used for mixing the materials, the exact mixing time allowed being 1½ minutes. These mixers inclined into discharge chutes that concentrated the materials into a control hopper positioned on the hillside below the plant, which discharged through a manually-controlled radial gate into a chute inclined on a 40 per cent grade, terminating at the base of the principal concrete tower.

Sand inundation was not practiced, but daily moisture determinations were carried out from which moisture additions were calculated. Slump tests were practiced to arrive at the total water, but judgment was based principally upon the appearance of the concrete and its consistency upon arrival at the dam. Meters equipped with turn-back dials were employed for measuring the water, by means of which the quantity for each batch was indicated directly. By this means, the total amount of water to be used could be checked against each batch placed.

The concrete coming from the mixer passed through the main chute to a hopper that was located near the base of a two-compartment main concrete tower, being from thence hoisted in a 2-yd. tilting skip bucket that was operated by electric hoists to elevated hoppers fastened to the tower. Its removal from this hopper took place from force of gravity through suspended counterbalanced chutes or troughs to tremie spouts and on to its destination. Among the placing equipment was used a 10-ton high line" that was indispensable in placing the concrete. It spanned a length of 1,280 ft. across the gorge.

The method of placing the concrete was in blocks between construction joints located on radial lines with the dam. Pours were placed in 5-ft. depths, the placing being done, as a general rule, on two night shifts beginning at 4:00 P. M. and terminating at 8:00 A. M. This made possible the use of the time between 10:00 A. M. and 4:00 P. M. for such tasks as the placing of forms, cleaning up the surface and other incidentals. All of the construction joints were recessed and grout holes were provided 10 ft. apart.

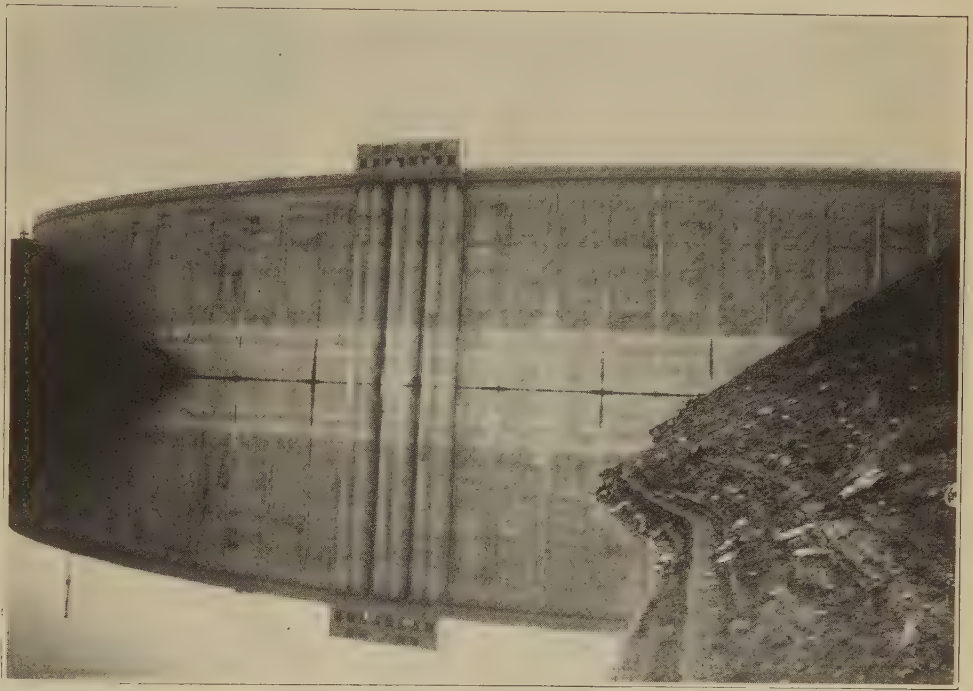
Claim Record in Handling Concrete

A record is claimed to have been achieved for concrete handling in the month of August, 1928, in which more than 67,000 cu. yds. were placed. The largest amount placed in any one eight-hour period was over 1,600 cu. yds., and the largest for any 24-hour period was 3,600 cu. yds. Between April 1, 1928, and the same date in 1929, 514,000 cu. yds. were mixed and placed. More than 750,000 barrels of cement were used in the dam.

Concrete of High Strength

Tests show that the compressive strength of the concrete in the dam exceeded by a considerable margin that required by the contract. Average 28-day strengths were 2,885 lbs. per sq. in. The mixture consisted of one barrel of cement per cubic yard of concrete. Supervisor L. H. Tuthill directed mixing operations. He was the concrete technologist for the East Bay municipal water district. Cylinders were taken daily from the main concrete chute below the mixing plant, and other cylinders were taken from the materials already placed in the dam. Inspectors in the employ of the district took these cylinders, which were broken after 7 days, 28 days, 3 months and 6 months by a 200,000-lb. testing machine. A cylinder was made from the specimen each day. Ten minutes later, in order that another sample might serve as a check, a second sample was taken from materials already in the dam, which invariably had greater strength than those first taken.

Upon some occasions three-shift periods of placing concrete made this operation almost continuous. The placing of too much concrete at a single point was avoided by frequently moving the "elephant trunk" from which the concrete emerged. Fifteen men were employed to work over the concrete while it was being deposited, directed by an inspector. These 15 men thoroughly cleaned the surface by brushing with stiff wire brooms that removed all laitance accumulated during the previous shift. This cleaning was later followed by another with picks and shovels, which were in turn followed with a brisk jet of water applied with compressed air. Then, before any more concrete was placed on the surface, this surface was covered with a thin application of cement grout, which was worked into the irregularities of the surface with wire brooms.



The completed structure from upstream

The dam was named Pardee dam in honor of Dr. George C. Pardee, president of the Board of Directors of the East Bay Municipal District. It will ultimately impound 222,000 acre feet of water. A remarkable illustration is shown of the completed dam, whose reflection in the water which it impounds is almost as distinct as the direct view above the waterline.

Good Practice in Concrete Floor Finish—Correction

The quantity of cement used, given in the tabulation on Page 34 of the May issue of CONCRETE in the article under the above title, should have read 138 bags instead of 13.8.

More Careful Grandstand Construction Object of New Code

A national safety code aimed to initiate more careful construction of grandstands will be undertaken at once by a national committee of engineers and construction experts under the leadership of the American Standards Association. This action follows the request for the establishment of such a code made by the Department of Labor and Industry of the State of Pennsylvania and other organizations.

The code when completed can be used by state and municipal regulatory bodies, insurance companies, and safety organizations. These bodies will be invited to appoint technical representatives to the committee which will prepare the code under the leadership of the standards association.

University Dedicates Laboratory

A two-day program marked the dedication of the Materials Testing laboratory and the celebration of the quarter centennial of the founding of the Engineering Experiment station at the University of Illinois on May 2nd and 3rd, at Urbana.

A conference on education in materials of engineering was part of the program.

Now a Reinforced Concrete Sailboat

A sailboat of reinforced concrete, containing four watertight compartments, has been built in Stockholm, Sweden, for a sailing enthusiast. The boat has a sail area of 360 sq. ft. The outside of the hull is unpainted and the keel is of steel.

New Canadian Roads

New Brunswick, a Canadian province now without any concrete roads, will spend $10,000,000 on new pavement within the next three years.

Concrete Masonry Vault Withstands Second Severe Fire

Conflagration in Lumber and Millwork Plant Fails to Damage Either Vault or Contents—Fire Lasts Several Hours—Vault Continues in Service

By F. R. ZAUGG

A disastrous fire swept the plant of the Modern Lumber and Millwork Co., at Tacoma, Wash., during the early morning hours of January 16, 1930. The two-story wood frame building, filled with kiln-dried manufactured lumber products, was a mass of flames at 2 a. m. and the fire lasted until noon. The building was completely destroyed and the entire half block area on which the plant stood was leveled to the ground, with the exception of a small concrete masonry vault which housed the office records.

The vault structure was built in 1910, just 20 years ago, by John I. Smitely, a concrete products manufacturer located near the burned plant, who is still doing business in the same location. He now has one of the largest concrete block and concrete pipe plants in the city.

The vault is 5 by 7 ft. in plan and 8 ft. high. Hand-tamped 8 by 8 by 16 in. block were used in its construction. A 4 in. plain concrete slab was placed over the top of the walls to form the roof of the vault.

First Fire in 1916

During 1916 the woodworking plant suffered its first fire and the small vault remained after the smoke cleared away, with no damage of any kind. When the plant was rebuilt the office was moved closer to the corner, and it was thought necessary at the time to raze the vault and build a new one at a different location. Mr. Smitely rose to the occasion, and took a contract to move the entire structure about 50 ft. He jacked it up, placed rollers underneath, and the vault was rolled to its present location, the new office and plant having been built around it. Here it has stood and is still standing in spite of the second disastrous fire.

Close-up view, showing warped steel door and overhanging part of roof slab broken off. No other damage occurred.

At 4 p. m. on the day of the fire the vault had cooled sufficiently to permit examination of the interior. The steel door, badly warped from the heat, was pried open. The asbestos covering on the outside of the steel door had completely fallen off due to the intense heat and to falling timbers. The records were found just as they had been left the night before. The top sheets of the various files were discolored by smoke that entered around the door frame, but these were plainly readable.

Vault Continues in Service

The only damage to the vault itself was the warped steel door and the slight damage to the plain concrete roof slab, which had a portion of the projecting front edge broken off by the falling timbers. The heavily loaded second floor joists had fallen directly across the top of the vault, thus causing this damage. Officials of the company were so well pleased with the saving of all records that they left them just as they were. A new padlock was placed on the door, and it was again closed. The writer viewed the interior of the vault two months after the fire. It had stood there during all the late winter storms without any additional protection. The inside was dry and the files were not even moist. There was no sign of rust on the small steel safe inside the vault, indicating that no cracks or other openings had been made by the fire.

Concrete masonry vault continues in service in midst of fire ruins

The plant is now being rebuilt and the little vault is being incorporated into the new building.

State Highway Department Cement Purchases Increase 42 Per Cent

Reports received by CONCRETE from 27 state highway departments show that departmental purchases of cement in states having comparable figures were 42 per cent greater in the period from January 1st to May 15th than in the corresponding period of 1929.

Thirteen of the 27 states reporting have no definite figures available, all cement purchases being made by contractors. Of the 11 states having comparable figures, two do not actually buy cement, but the department keeps account of the amount bought by contractors.

Three states that have bought a total of 2,660,600 barrels since January 1st did not buy cement last year. This indicates an increase in the tendency of state highway departments to buy cement direct.

The comparative figures follow:

State Highway Department Cement Purchases in Bbls., Jan. 1st to May 15th

	1929	1930
Bought by states having comparable figures	11,352,500	16,041,700
Bought by 3 states that did not buy in 1929		2,660,600
Totals	11,352,500	18,702,300

Manipulation of Concrete Floor Finish Illustrated

Discussion of Report of Committee 802 of the American Concrete Institute Emphasizes Good and Bad Practice—Photographs Illustrate Proper Methods—Step-by-Step Finishing Procedure Described

By W. E. HART

An abstract of the first part of the report of Committee 802 of the American Concrete Institute, published in the May issue, sets forth the causes back of inferior floor finishing work, makes definite recommendations regarding materials and proportions and describes the procedure to be followed in manipulating the finish. The recommendations were based on actual experience supplemented by laboratory experiments.

In this issue W. E. Hart, one of the members of Committee 802, presents an illustrated discussion of the procedure recommended by the committee.

The specifications offered as a part of the report of Committee 802 will be published in the July issue of "Concrete."

THE intention of this discussion is to show the trouble that usually arises when improper methods of workmanship are combined with the use of 1:2 mortar topping, and how easy it is to produce a satisfactory finish through the use of proper materials and proportions, along with intelligent manipulation.

Over-manipulation of floors causes 90 to 95 per cent of the trouble, assuming that strictly sound materials are used. At the same time, if the recommendations of committee 802 are followed, concrete floor finishes can be constructed without increasing the cost, and without leaving a film of inert material at the surface to dust off.

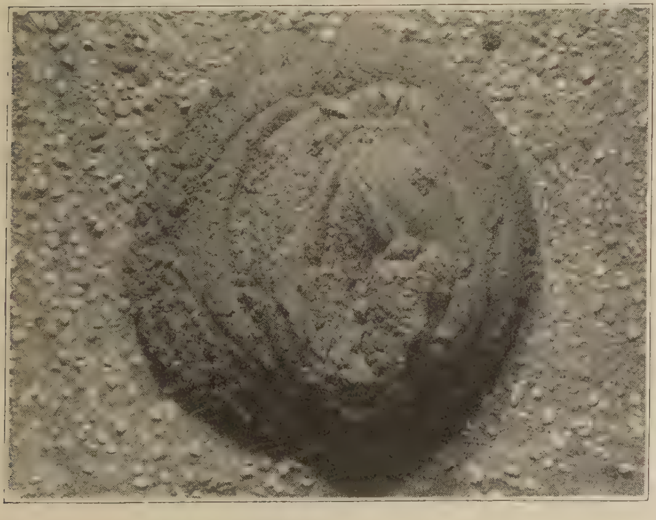


Figure 1

Photographs Illustrate Essential Steps

The photographs here reproduced have been taken to illustrate the essential steps involved in obtaining the proper quality of finish. Figure 1 shows a 1:2 mortar top on the base before being spread and struck off. Note that the base was broomed just before it hardened, thus exposing the coarse aggregate. This treatment tends to produce an excellent surface to which topping will bond, but the mortar is improperly proportioned.

Figure 2

Figure 2 shows the mortar topping after it has been struck off and floated. General practice, in the East at least, has been to dust on cement or a combination of cement and fine sand to absorb the excess moisture. This procedure may assist in early finishing of the job, but it places fine materials on the top where they will be subjected to traffic and wear. Later pictures will show why this method should not be employed.

Figure 3 shows the condition of the surface after a period of 15 days. Crazing is only in the top surface, which is composed of soft material that has been brought up by excessive troweling and the dusting on of fines. The photograph as reproduced is approximately full size.

Figure 4 shows a section of the 1:2 mortar top and base after it is about 20 days old. The top layer of soft permeable material is plainly visible, in the thin, light-colored layer about ⅛ of an inch thick. This picture shows the slab cut in two and a small section about ¾ in. wide removed with the use of a silicon carbide stone.

Grinding down of the top of the floor proceeded until fine grains of sand began to show up. It is this 1/8 to 1/16-in. top that causes the greatest amount of trouble in floors. It is soft and will absorb oil and become stained, and it dusts off under traffic.

Figure 3 (Full size)

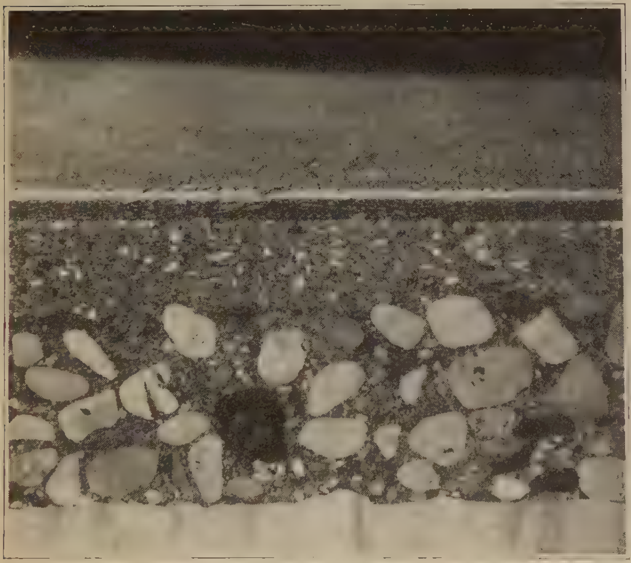


Figure 4

Figure 5

Figure 5 shows another type of base. A stiff broom was used to remove mortar and laitance brought to the surface when the structural concrete slab was struck off. Brooming should be done after the slab has been allowed to set for from 2½ to 3 hours, depending upon weather conditions.

Figure 6 shows the recommended mixture of 1 part of cement, 1 part of coarse sand, and 2 parts of fine gravel graded from 1/8 to 1/4 in., with all material passing a 3/8-in. screen. This picture was made for the purpose of demonstrating the proper consistency of the mixture. The quantity of water was 5 gallons to the sack of cement, including the moisture in the aggregates.

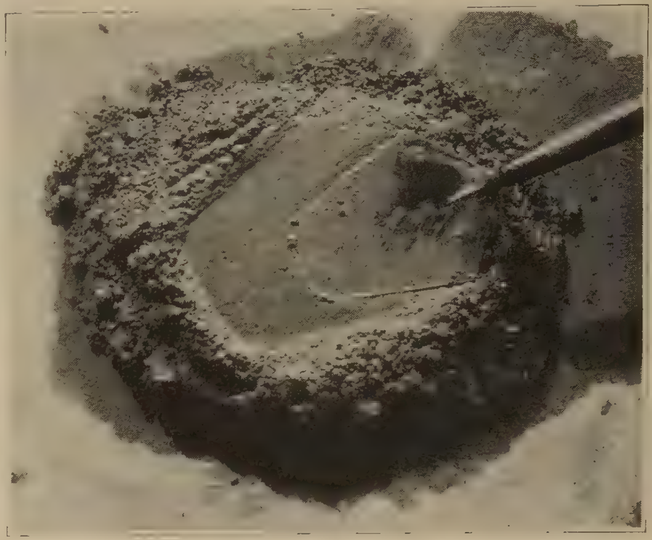


Figure 6

Figure 7 shows the striking off of the slab, proceeding from right to left. Figure 8 shows the condition of the slab after it has been floated.

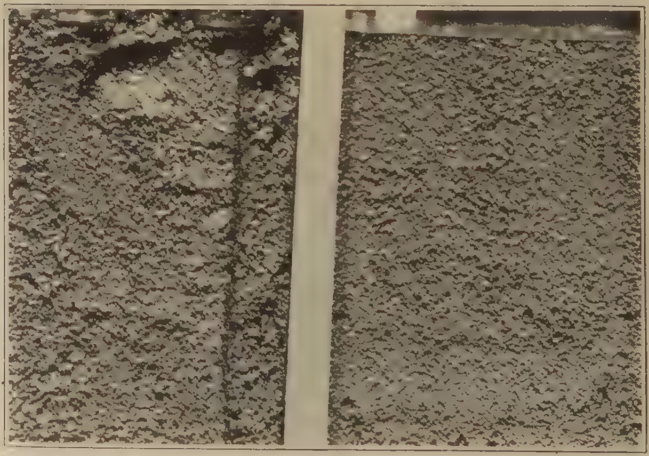


Figure 7

Exact Finishing Operation Described

At this particular point it may be well to digress long enough to describe the step-by-step procedure necessary to obtain a satisfactory and serviceable finish. In the placing of a coarse aggregate topping, 30 to 45 minutes should be allowed to elapse before the topping is troweled. The procedure to follow is to wet down the structural con-

Figure 8

Figure 9

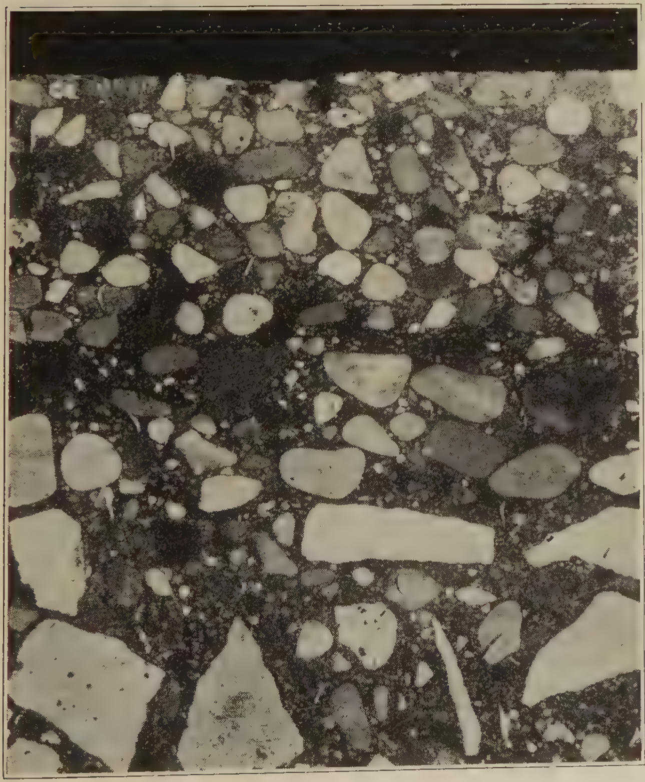


Figure 10 (*Full size*)

crete base sufficiently to set up suction, but do not have pools of water standing on the slab. Place the topping and strike it off true to grade. After it is struck off it should be floated *but not troweled* until about 30 to 45 minutes after the floating operation. During this time the topping will tighten or harden sufficiently to prevent fine materials from being drawn to the surface in the trowel-finishing operation. In other words, the water sheen should have completely disappeared from the surface of the slab. When this condition is noted the finisher will find that the slab is somewhat hard, and may feel that it should be wet down before finishing. However, this should not be done. The slab should now be finished with a steel trowel. This will bring a very thin film of mortar to the surface, sufficient to give the floor the right kind of a finish. The topping will be sufficiently stiff so that all particles extending above the surface can be forced down into it, but excessive amounts of fine materials cannot be brought up.

Figure 9 shows the condition of the surface about 7 hours after finishing. The speckled appearance is caused by particles of fine stone showing through the very thin film of mortar.

Figure 10, the final picture, is a cross-section cut from the slab. The reproduction is approximately full size. There is no mortar on the top, and all of the coarse aggregate is retained at the surface where it will take the wear. It will be found that the surface is hard and impervious, with nothing to dust off, and maintenance will be very low.

Aluminum Fittings on Concrete Poles Save Painting

Angle cross-arms and lighting fixtures of aluminum are used on concrete poles in factory yards of an Aluminum Company of America plant in northern New York. Rust stains on the poles are eliminated.

The combination of aluminum fittings and concrete pole requires no paint

Steel Beams Much Stronger When Encased in Concrete

Randall Committee Reports to Western Society of Engineers on Results of Load Tests at Gary, Ind.—Tests Show Common Action Between Concrete and Steel—Will Attempt to Amend Chicago Building Regulations

THE special committee appointed by the Western Society of Engineers to conduct a series of load tests on concrete-encased steel beams and girders at the plant of the American Bridge Company in Gary, Indiana, during the latter half of 1929, presented its report before a meeting of that society on May 12th.

The 69-page report, entitled "Test of Steel Floor Framing Encased in Concrete," is presented in three parts. The first part, by Sidney G. Martin, contains a brief review of various published reports of tests or investigations of the composite action between structural steel beams and the concrete in which they were encased. Part II, by Charles C. Whittier, covers the method of construction, the quality of materials, the conduct of the tests and the method of recording the test results.

Part III, by Frank A. Randall, contains the analysis of the test data and the recommendations of the committee.

The construction of the floor system subjected to this test was described on Page 24 of the November, 1929, issue of CONCRETE, under the heading, "Testing Concrete-Encased Steel Beams and Girders."

Extent of Tests

The floor construction was not tested to destruction. In fact, the load tests were not continued far enough to stress the steel to its elastic limit. The committee members feel, however, that the work was continued far enough to obtain the design data desired. The structure has been demolished since the conclusion of the tests.

The structural steel members were subjected to load tests and deflection measurements before the panels were concreted, and the same members were again measured for deflection after the concrete had hardened for 28 days and the test loads were imposed.

Deflection measurements and gauge line readings were taken at several stages. The first measurement tabulated for any particular beam or girder was for the dead load. The second test readings were taken when the imposed test load was approximately equal to the design load of 100 lbs. per sq. ft. Two additional readings were taken under greater loads, the final deflection measurements and gauge line readings having been taken when the test load was about twice the sum of the dead load and the design load.

Comparing Test Results with Usual Design Computations

With the tests tabulated, the committee compared the actual stresses in the structural steel members, as determined from the deflectometers and strain gauges, with the computed stresses as determined by ordinary design practice. As might be expected, the indicated tensile stress in the bottom flange of the steel members was much greater than the compressive stress in the upper flange of the same members. This difference is due primarily to the fact that the concrete in the upper part of the composite beams and girders took a considerable share of the compressive strength, whereas the concrete around the lower flange of the steel members probably did not assist in taking tensile stress. This had the practical effect of raising the neutral axis of the members, considered as composite beams, so that the tensile strength in the lower flange was reduced considerably below what it would have been if unencased.

Without going into minute detail it will be sufficient to say that the measured stresses in the tension flanges of fully loaded beams averaged 56 per cent of the so-called computed stresses in the cinder concrete panels, and 57 per cent in the gravel concrete panels. The corresponding percentages in the compression flanges were 34 and 45 per cent, respectively. The term "computed stress" denotes the theoretical stress obtained by usual design methods when the steel section is regarded as carrying the entire load.

In view of these facts the committee recommended unanimously that with materials of the quality used in this test, concrete-encased steel beams and girders in the form of structural steel I-beams up to 24 in. in depth, when wrapped in steel wire fabric or mesh and encased in a rectangle of concrete with a minimum covering of 2 in. on the flanges of the I-beams, and when used in connection with concrete floor slabs not less than 2½ in. above the top flanges of the I-beams, may be designed by considering the structural steel section alone but placing the allowable unit working stress at 24,000 lbs. per sq. in.

It is the intention of the committee, with the support of the Western Society of Engineers, to recommend the adoption of an amendment to the Chicago city building regulations permitting concrete-encased steel beams and girders to be designed in accordance with the foregoing recommendation.

The committee report is published in full in the June, 1930, issue of the Journal of the Western Society of Engineers.

The committee consisted of Frank A. Randall, consulting engineer, Chicago, chairman; Homer G. Farmer, of the Universal Atlas Cement Company; John Brunner, of the Illinois Steel Company; Charles C. Whittier, of the Robert W. Hunt Company; and Albert Reichmann, of the American Bridge Company. Copies of the full report of the committee may be obtained from the Western Society of Engineers.

Coming Convention

June 23-27—American Society for Testing Materials, thirty-third annual meeting. Chalfonte and Haddon Hall hotels, Atlantic City, N. J.

Method of Calculating Strength of Steel Beams Encased in Concrete

Rational Method of Analysis of Composite Steel and Concrete Beam Sections Here Presented for First Time—Deflection and Stress Reduced by Presence of Concrete—Bond and Shear Also Considered

By O. H. MENGERING
Carl M. Geupel Construction Co., Indianapolis

This theoretical analysis of composite beam sections of concrete and structural steel comes at an opportune time, in view of the report on load tests of such construction issued on May 12th by the Western Society of Engineers. The Western Society report is described briefly elsewhere in this issue.—The Editors.

THE February, 1930, issue of CONCRETE contains an article on page 29 on "Strength of Steel Beams Encased in Concrete," although the author does not give any method of calculation for designing structures of this type. It is the purpose of this article to present such a method. The symbols and notations used here are those customary in the design of reinforced concrete structures. Their meaning may be found on page 219 of the "Handbook of Reinforced Concrete Building Design," published by the Portland Cement Association and other organizations, in September, 1928.

In addition, the following symbols will be used:

h = total height of structural steel beam.
a = thickness of concrete above top of steel beam.
I = moment of inertia of compound section about its neutral axis.
I_s = moment of inertia of structural steel section given in handbooks of rolling mills.
S = statical moment of compound section about the top of the concrete.
A = area of compound section in terms of transformed steel area.
A_s = area of structural steel section as given in handbooks of rolling mills.

The location of the neutral axis of a compound section, or its center of gravity, is determined by the equation

$$kd = \frac{S}{A} \quad . \; . \; . \; . \; . \; . \; . \; . \; . \; . \; . \; . \; . \quad (1)$$

The area of a compound section in terms of a transformed steel section is $A = A_s + \frac{1}{n}\text{bkd}$ . . . (2)

The statical moment of a compound section about the top of the concrete, in the same terms, is

$$S = A_s\left(\frac{h}{2} + a\right) + \frac{1}{n}\,b\frac{(kd)^2}{2} \quad . \; . \; . \; . \; . \; . \; . \quad (3)$$

With these three equations kd may be computed for any given section.

Supplying Additional Steel in Compression

Stress should be laid on the desirability of supplying sufficient material in compression to balance the steel area in tension. This is the general practice in reinforced concrete construction. If this is done—that is, if all materials are stressed up to the permissible limits, the location of the neutral axis becomes a known quantity and is the same as that for any balanced reinforced concrete section. For instance, assuming the permissible extreme tension for structural steel at $f_s = 18{,}000$ lbs. per sq. in., and the permissible extreme compression stress in bending for concrete at $f_c = 800$ lbs. per sq. in. with an ultimate strength of concrete of 2,000 lbs. per sq. in., and the ratio of the moduli of elasticity at $n = 15$, then

$$k = \frac{1}{1 + \frac{f_s}{nf_c}} = \frac{1}{1 + \frac{18{,}000}{15 \times 800}} = 0.40 \quad . \; . \; . \; . \quad (4)$$

Other grades of concrete may be used. The following tabulated grades of concrete give the same values for k:

Grades of Concrete for Which Value of $k = 0.40$

Compressive strength in lbs. per sq. in.	Allowable flexural stress, in concrete, in. lbs. per sq. in.	Value of modulus ratio n	Value of k in Formula (4)
2,000	800	15	0.40
2,500	1,000	12	0.40
3,000	1,200	10	0.40
3,750	1,500	8	0.40

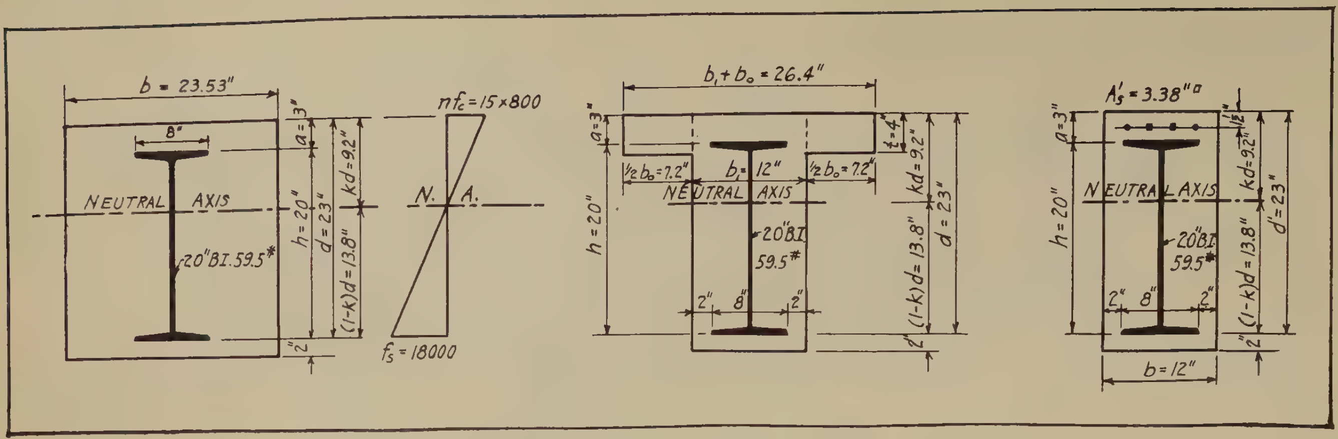
Assuming that the compound beam is of rectangular section, it will be possible to calculate the width required for a balanced section. By combining equations (1), (2) and (3), we obtain

$$kd = \frac{S}{A} = \frac{A_s\left(\frac{h}{2} + a\right) + \frac{1}{n}\,b\frac{(kd)^2}{2}}{A_s + \frac{1}{n}\,bkd}.$$

Solving this equation for b we find

$$b = \frac{2nA_s}{(kd)^2}\left(\frac{h}{2} + a - kd\right) \quad . \; . \; . \; . \; . \; . \; . \; . \quad (5)$$

It may not be possible or desirable to provide this full width b. If the available width on the compression side of the neutral axis is only b, then a substitute for the missing width, $b_2 = b - b_1$ will have to be found. This may be accomplished by adding a concrete tee flange on one or both sides of the beam or by placing compresssion steel in the concrete. Methods of design for such cases are given farther on in this article.



In accordance with one of the fundamental formulas of statics the extreme fiber stresses are

$$f_s = \frac{M}{I}(1 - k)d \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (6)$$

$$f_c = \frac{M}{nI}kd \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (7)$$

The moment of inertia of a compound section is

$$I = I_s + A_s\left(\frac{h}{2} + a - kd\right)^2 + \frac{1}{n}\,\frac{b(kd)^3}{3} \quad . \quad . \quad (8)$$

Substituting the value for b for balanced sections given in equation (5), we obtain

$$I = I_s + A_s\left(\frac{h}{2} + a - kd\right)\left(\frac{h}{2} + a - \frac{1}{3}kd\right) \quad . \quad . \quad (9)$$

This equation shows that the value of I is not influenced by the value of n.

With these equations any problem of design can be solved. It is, however, desirable to consider further how a balanced section may be found. The value for b for the simplest case of a rectangular section has already been given. If any other section is selected, its moment of inertia must be equal to that given in equation (8). Only the last member of this equation is dependent on b. For a width b_1 of the stem smaller than b, that portion of I which has to be provided for in some other way will be

$$I_o = \frac{1}{n}(b - b_1)\frac{(kd)^3}{3} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (10)$$

Let the width of a concrete tee flange be "b_o" outside of the stem and the thickness of the tee be "t," then its moment of inertia will be

$$I_o = \frac{1}{n}b_o\frac{t^3}{12} + \frac{1}{n}b_o t\left(kd - \frac{t}{2}\right)^2 \quad . \quad . \quad . \quad . \quad . \quad . \quad (11)$$

Equalizing equations (10) and (11) we find, multiplying both with n

$$(b - b_1)\frac{(kd)^3}{3} = b_o\frac{t^3}{12} + b_o t\left(kd - \frac{t}{2}\right)^2 \text{ or}$$

$$b_o = \frac{(b - b_1)(kd)^3}{3\left[\frac{t^3}{12} + t\left(kd - \frac{t}{2}\right)^2\right]} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (12)$$

or neglecting the small amount of $\frac{t^3}{12}$

$$b_o = \frac{(b - b_1)(kd)^3}{3t\left(kd - \frac{t}{2}\right)^2} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (13)$$

It is also possible to introduce compression steel in the form of bars or a plate in place of the missing compression material. In this case we have $I_o = A'_s f^2$, where f is the distance from the center of gravity of compression steel to the neutral axis. We then have $\frac{1}{n}(b - b_1\frac{(kd)^3}{3} =$

$$A'_s f^2 \text{ or } A'_s = \frac{1}{n}(b - b_1)\frac{(kd)^3}{3f^2} \quad . \quad . \quad . \quad . \quad . \quad . \quad (14)$$

Bond Between Concrete and Steel

There remains one other consideration of importance—the bond between the concrete and the top of the structural steel section. The horizontal shear H at any horizontal plane is equal to the vertical shear V at this location, divided by the moment of inertia nI and multiplied by the statical moment S_1 of that portion of the section located above this horizontal plane, in reference to the neutral axis. For the concrete above the top of the structural steel beam there is

$$S_1 = ab\frac{h + a}{2}, \text{ therefore}$$

$$H = \frac{V}{nI}ab\frac{h + a}{2} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (15)$$

In figuring bond stresses, only that portion of H will have to be taken into consideration which corresponds to the width of the steel flange. The remainder will travel down through the concrete.

In order to illustrate the method of computation, let us assume a 20-in. Bethlehem I-beam weighing 59.5 lbs. per lin. ft. For this beam the depth $h = 20$ in., the width of the top flange is 8 in., and the moment of inertia $I_s = 1181.5$ and $A_s = 17.47$ sq. in. Let us assume $a = 3$ in. and $d = 23$ in., $f_c = 800$, $f_s = 18{,}000$, $n = 15$, $k = 0.40$. If sufficient concrete is provided to balance the steel section, then with equation (9) we find that $I = 1840.7$ in.^{4} The required width for a balanced section according to equation (5) is $b = 23.53$ in.

If any of the other above mentioned grades of concrete is used, the moment of inertia for the balanced section does not change. This is true for any combination of stresses which give a value of $k = 0.40$. The required width, of course, differs with the grade of concrete, and is, as shown in equation (5), inversely proportional to n. Therefore, if b is known for one basic quality of concrete, it can be proportioned for any other quality for which k has the same value. Take, for instance, 3,000-lb. concrete with $n = 10$. Then $b = 15.69$ in. For computing the resisting moment of a compound section equations (6) and (7) may be modified, so that

$$M = I\frac{f_s}{(1-k)d} = 2{,}401{,}000 \text{ in.-lbs.}$$

$$M = I\frac{nf_c}{kd} = 2{,}401{,}000 \text{ in.-lbs.}$$

The resisting moment for the same I-beam without concrete is $M_s = 2{,}126{,}700$ in.-lbs. Thus the addition of concrete increases M for this particular section about 13 per cent.

The deflection of a beam with simple supports and uniform load is

$$D = \frac{5}{384}\,\frac{Wl^3}{EI}, \text{ or with } M = \frac{Wl}{8},\ D = \frac{5}{48}\,\frac{Ml^2}{EI}.$$

For the same load and the same span, D will decrease in inverse proportion of the moments of inertia or, in our case, with $\frac{I_s}{I} = \frac{1181.5}{1840.7} = 0.64$, representing a decrease of 36 per cent.

If the beam with concrete is loaded to full capacity, this decrease will be $\frac{I_s M}{I M_s} = 0.64 \times 1.13 = 0.275$, or 27.5 per cent decrease of deflection.

These increases of load capacity and decreases of deflection will vary with the section. Therefore, in dimensioning a section for given load conditions it will not be practical to assume a proportional increase of steel stress. It is a comparatively simple matter, however, to calculate the value of M for each balanced compound section and put it down in the tables given in steel handbooks, assuming that dimension $a =$ thickness of concrete above the top of a steel section is 3 in. or any other given quantity. The width b required for a balanced section for 2,000-lb. concrete may also be put down in this table. For other grades of concrete b can be proportioned in the inverse ratio of the various values for n, as shown above.

In our example, it may not be desirable to make the concrete stem any wider than required for protecting the edges of the steel flanges, or 2 in. wider on each side than these flanges, or a total width of 12 in. In all probability there will be a concrete flange available to provide enough compression material. Let us assume the thickness of this tee flange at $t = 4$ in. Equation (13) gives the width b_o required for this flange.

For 2,000-lb. concrete we found $b = 23.53$ in. Therefore, from equation (13), $b_o = 14.4$ in., in addition to the 12 in. width of stem.

This dimension b_o should be limited to $8t$ on each side, or to one-half the clear distance between adjacent beams, or to one-quarter of the beam span; or as otherwise specified by regulations for reinforced concrete construction (see page 223 of "Handbook of Reinforced Concrete Building Design").

Where no concrete flange is available, compression steel may be used in the form of loose bars, or a plate riveted to the top. Using bars located 1½ in. below the top of the concrete, we have, in our example, $f = kd - 1\frac{1}{2} = 7.7$ in., and, with equation (14), $A'_s = 3.38$ sq. in. The required length of these bars will be found from the moment diagram, allowing enough length for developing the bars in bond beyond the points where they are needed for the moment.

Shear and Bond

The final consideration is that of shear and bond. Assuming a span of 20 ft. we have $M = \frac{w \times 20^2}{8} = \frac{2{,}401{,}000}{12}$ and $w = \frac{2{,}401{,}000 \times 8}{12 \times 20^2} = 4{,}000$ lbs. per ft. of span. With this load, the end reaction will be $V = 40{,}000$ lbs. This is less than the shear permissible on this steel section. The horizontal shear at the top of the I-beam, according to equation (15), is $H = 600$ lbs. per in. of length. The unit shear on a 12 in. wide concrete stem is then 600/12, or 50 lbs. per sq. in. at the top of the beam. It also represents the bond stress between concrete and top of steel. This is below the permissible value of 80 lbs. per sq. in. as specified for plain bars in 2,000-lb. concrete.

It will be of great interest to compare results of the Gary tests conducted by the Western Society of Engineers and reported to that organization on May 12th, with values calculated by the above method. Any discrepancies which may be in evidence should then be analyzed in order to justify the above method or amend it. In the Western Society's investigation the grade of concrete used and its elastic properties will be of utmost importance.

Placing Concrete on Storm Drain Project in San Francisco

In order to provide adequate drainage for an extensive area of hilly terrain, the City and County of San Francisco is engaged in the construction of a mammoth storm

Placing truck-mixed concrete on storm drain job drain covering a part of the route of the old Ocean Shore railroad in the southern section of the city. Upon completion of this project, the new Alemany boulevard will cover the storm drain for a considerable distance.

The section now under construction, known as Section A, will have a length of 3,000 linear ft., utilizing 40.64 cu. ft. of concrete per linear foot. The size of this drain averages 8 ft. 6 in. in height and 10 ft. 3 in. in width. The walls are 1 ft. thick, the reinforcing steel runs 227 lbs. per linear foot, and the bottom is lined with brick.

All concrete is being designed and placed under the personal direction of Carroll Stephens, manager of the Golden Gate-Atlas Materials Company, which is furnishing transit-mixed concrete for this project. The maximum haul is 2½ miles and the trucks average ten trips per day. The concrete mixture is in accordance with Grade "B" of the city specifications. Celite is added to the amount of 3 per cent of the weight of the cement.

The Clinton Construction Company are the contractors, the work being done under the personal direction of W. B. Brinker, president and general superintendent. The job superintendent is Theodore Petersen.

The Alemany boulevard storm drain is being constructed by the City and County of San Francisco under the personal direction of M. M. O'Shaughnessy, city engineer and builder of the Hetch Hetchy water system.

How to Save in Concrete Form Work

Sixth of a Series of Articles on Details of Economical Concrete Forms—Drop Panel Support—Typical Form Work—Shoring and Stripping

VI—Forms for Drop Panels in Flat-Slab Construction

By A. B. MacMILLAN
Chief Engineer, Aberthaw Company, Boston, Mass.

THE principal feature in the form work for a drop panel around the column head in flat-slab construction consists of a square panel or platform that forms the bottom of the concrete drop panel. A circular hole is cut in the center of the panel to practically the same diameter as the diameter of the top of the column capital. This panel is in reality made up of two equal parts, each part having a semi-circular hole cut out of one side, as shown in Figure 30. This illustration shows in sufficient detail how the panels are made up.

These panels are the ones marked P-1 in the key plan shown in Figures 24 and 25 in the May installment of this series.

Supporting the Form Work

The form work for a drop panel is supported in much the same way as the floor slab, namely, by a framework of joists and girts which in turn are supported by 3-by-4 or 4-by-4 centering posts.

Observe in Figures 32, 33 and 34, that the connection between a post and a girt is exactly as shown in Figures 28 and 29 of the article preceding this one. As in the former case, the final adjustment of levels is made with the wedges driven between the girt and the top of the post, after which the connection is made secure with two 10d double-headed nails driven through the 1-by-4 scab and into the girt.

The posts are braced horizontally, in each direction, with 1-by-6 boards at least 6 feet in the clear above the floor.

Examination of Figures 31 and 32 discloses that two girts (one along each side of the drop panel) furnish the entire support for the drop panel form work. The two girts are in fact a part of the regular floor slab form system described in the May issue of this series of articles. They are at the same level as the remaining girts in the floor form work.

Note in Figure 32 that the girts may be some distance beyond the edge of the drop panel. Their exact position is in reality determined by the requirements of the floor slab form system, and is not dependent on the dimensions of the drop panel.

The final support of the panels forming the bottom of the drop panel is supplied by four panel joists, either 3 by 7¾ or 3 by 9¾ inches in size, and spaced as indicated in Figures 31 and 33. These four joists are supported by hangers attached to the girts, the hangers being of a type that permits removal of the joists when the forms are to be stripped.

Figure 34 will be of further assistance in a study of the details of this form work, since it illustrates the work as viewed from below.

The Panels

The details of the two halves of the panel forming the bottom of the drop panel are so well illustrated in Figures 30, 32 and 33, that little need be added by way of description. The relation between this panel and the panels of the floor slab forms are clearly illustrated in Figures 32 and 33. As indicated in these drawings, the panels consist of ⅞-inch tongue-and-grooved material nailed to cleats of dressed 2-by-4's or 3-by-4's. The panel extends 3 inches beyond the edge of the concrete drop panel all around, so that its dimensions are 6 inches greater than those of the drop panel.

The diameter of the hole in the center of the panel is dependent on the requirements of the sheet metal form for the column capital. In flat-slab construction the universal practice is to use sheet metal forms for columns and column capitals, and different types require different diameters in the hole in this panel. The metal forms we use permit the hole to be cut to the exact diameter of the top of the finished column capital, but other systems require a slightly larger hole. The exact diameter can ordinarily be determined only from the details supplied by the manufacturer of the column forms.

After the panel is set in place its sides are closed with dressed 2-inch pieces whose dressed height is the distance between the bottom of the finished concrete drop panel and the finished floor slab, less $\frac{7}{8}$ of an inch. A $\frac{7}{8}$-inch fillet is then tacked all around the top of the drop, to produce a suitable finished appearance.

At the Wall Column

Figures 35 and 36 illustrate the details of the form work at a typical wall column and drop panel in flat-slab construction. Provision must be made for a drop panel of about half the area of an interior drop panel. The work is assembled in much the same way as at an interior column, except that the column itself is rectangular, and in place of the circular column capital of an interior column there is a haunch. Furthermore, the form work for the column and haunch are not usually of metal, as with interior columns, but of wood, as illustrated in Figures 14 and 15 in the March installment of this series. Figures 14 and 15 should accordingly be studied in connection with Figures 35 and 36.

Shoring and Stripping

No special shoring of the drop panel is required, since the column itself provides all the shoring required at this point. The shoring of the remaining part of the floor bay was fully explained in the fifth article of this series, published in May.

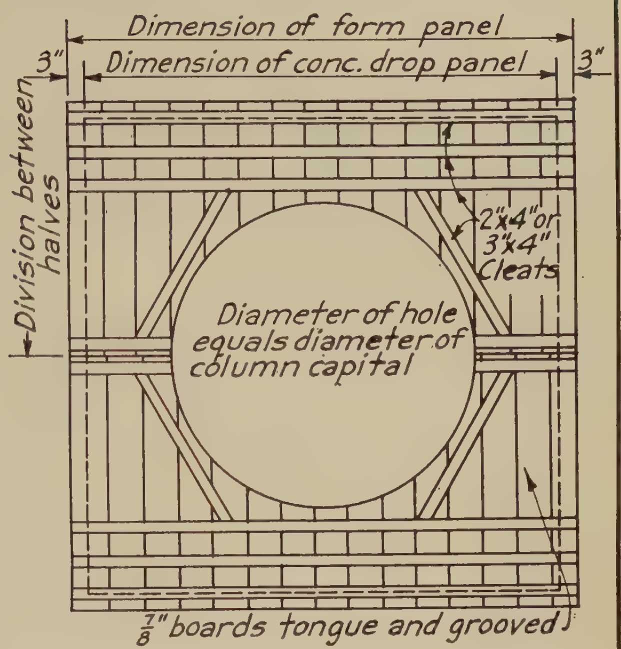

Dimension of form panel
3"
Dimension of conc. drop panel
3"
Division between halves
2"x4" or 3"x4" Cleats
Diameter of hole equals diameter of column capital
$\frac{7}{8}$" boards tongue and grooved

FIGURE 30-FORM PANEL FOR BOTTOM OF CONCRETE DROP PANEL (VIEWED FROM BELOW)

Stripping of the form work of the drop panel must be done in connection with the stripping of the rest of the

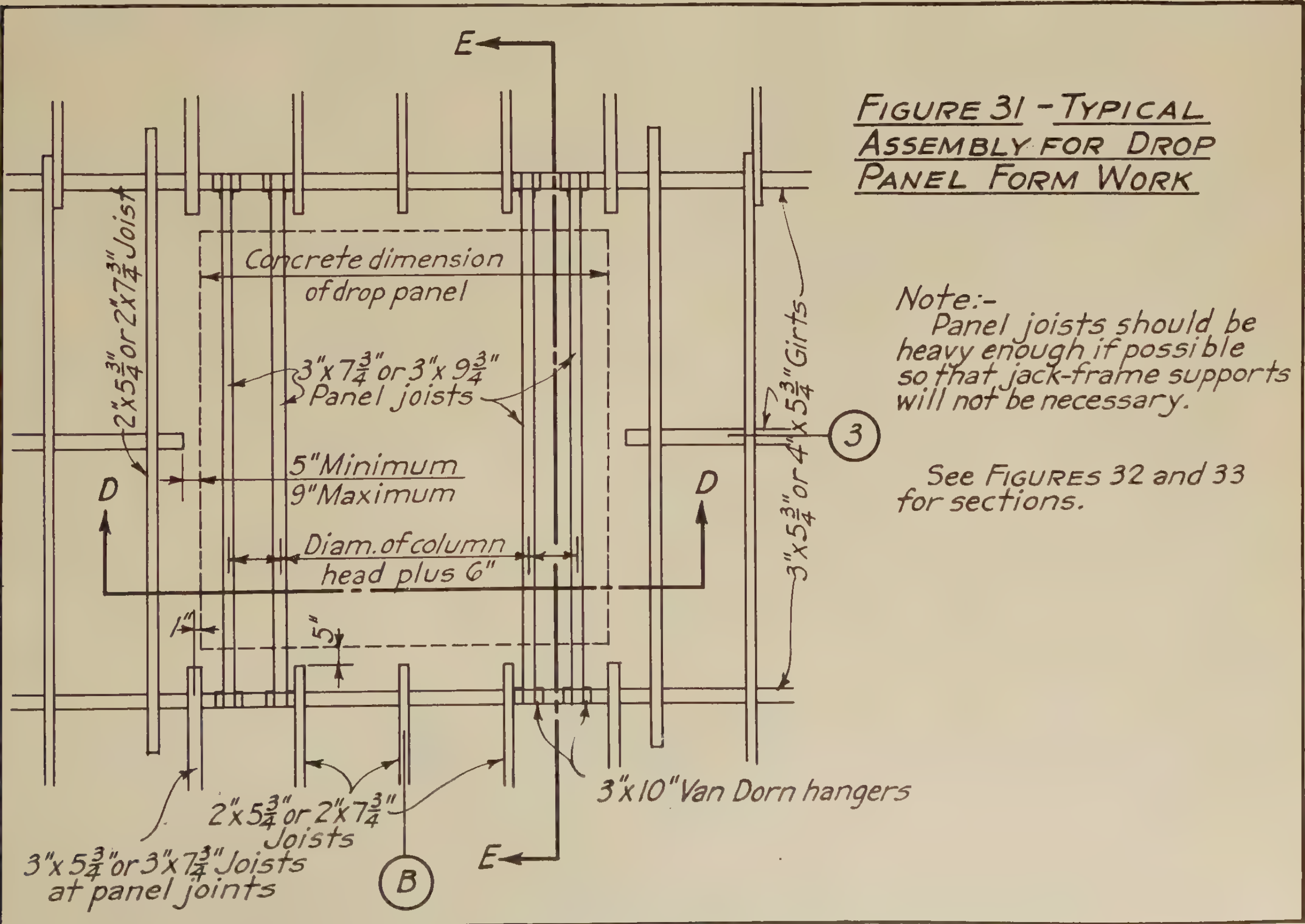

E
Concrete dimension of drop panel
2"x5$\frac{3}{4}$" or 2"x7$\frac{3}{4}$" Joist
3"x7$\frac{3}{4}$" or 3"x9$\frac{3}{4}$" Panel joists
5" Minimum
9" Maximum
D
D
Diam. of column head plus 6"
1"
5"
3"x5$\frac{3}{4}$" or 4"x5$\frac{3}{4}$" Girts
3
2"x5$\frac{3}{4}$" or 2"x7$\frac{3}{4}$" Joists
3"x5$\frac{3}{4}$" or 3"x7$\frac{3}{4}$" Joists at panel joints
B
E
3"x10" Van Dorn hangers

FIGURE 31-TYPICAL ASSEMBLY FOR DROP PANEL FORM WORK

Note:-
Panel joists should be heavy enough if possible so that jack-frame supports will not be necessary.

See FIGURES 32 and 33 for sections.

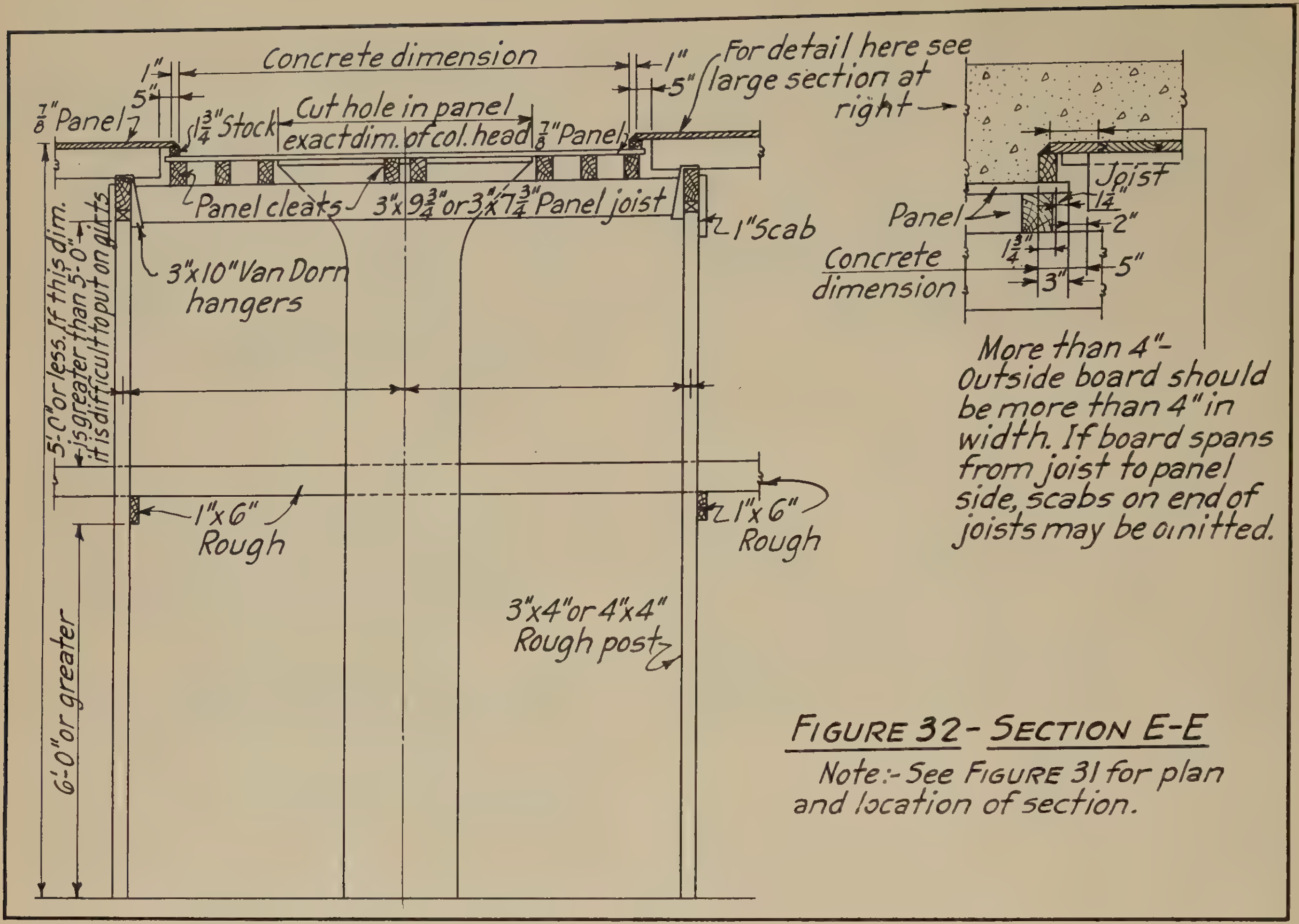

Concrete dimension
1"
5"
7/8"Panel
1 3/4"Stock
Cut hole in panel exact dim. of col. head
7/8"Panel
1"
5"
For detail here see large section at right
Panel cleats
3"x9 3/4"or 3"x7 3/4"Panel joist
1"Scab
3"x10"Van Dorn hangers
5'-0"or less. If this dim. is greater than 5'-0" it is difficult to put on girts
1"x6" Rough
1"x6" Rough
3"x4"or 4"x4" Rough post
6'-0"or greater
Joist
Panel
1/4"
2"
Concrete dimension
1 3/4"
5"
3"
More than 4"-
Outside board should be more than 4" in width. If board spans from joist to panel side, scabs on end of joists may be omitted.

FIGURE 32 - SECTION E-E

Note:- See FIGURE 31 for plan and location of section.

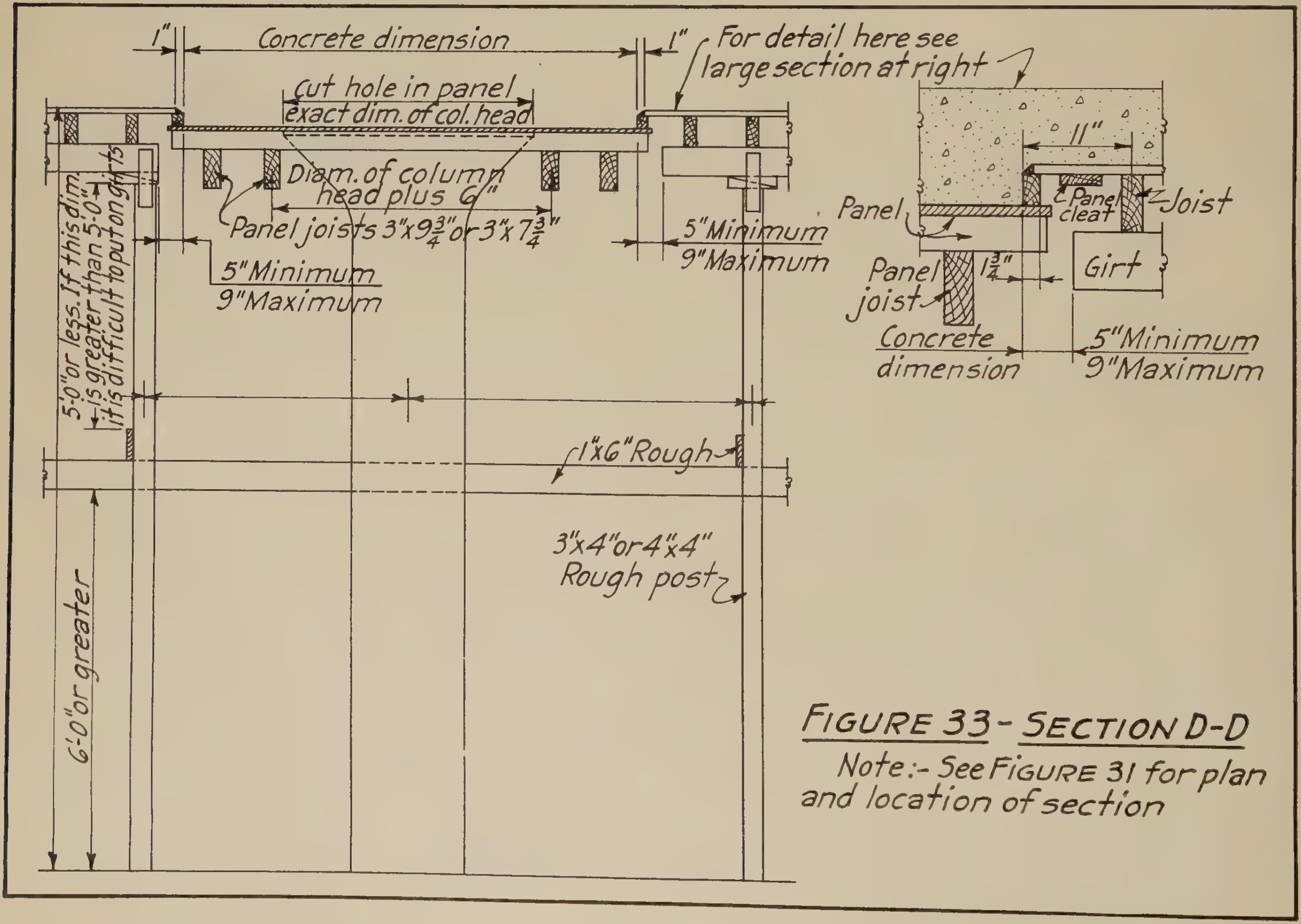

1"
Concrete dimension
1"
For detail here see large section at right
Cut hole in panel exact dim. of col. head
Diam. of column head plus 6"
Panel joists 3"x9 3/4" or 3"x7 3/4"
5"Minimum
9"Maximum
5"Minimum
9"Maximum
5'-0"or less. If this dim. is greater than 5'-0" it is difficult to put on girts
1"x6"Rough
3"x4"or 4"x4" Rough post
6'-0"or greater
11"
Panel
Panel cleat
Joist
Panel joist
1 3/4"
Girt
Concrete dimension
5"Minimum
9"Maximum

FIGURE 33 - SECTION D-D

Note:- See FIGURE 31 for plan and location of section

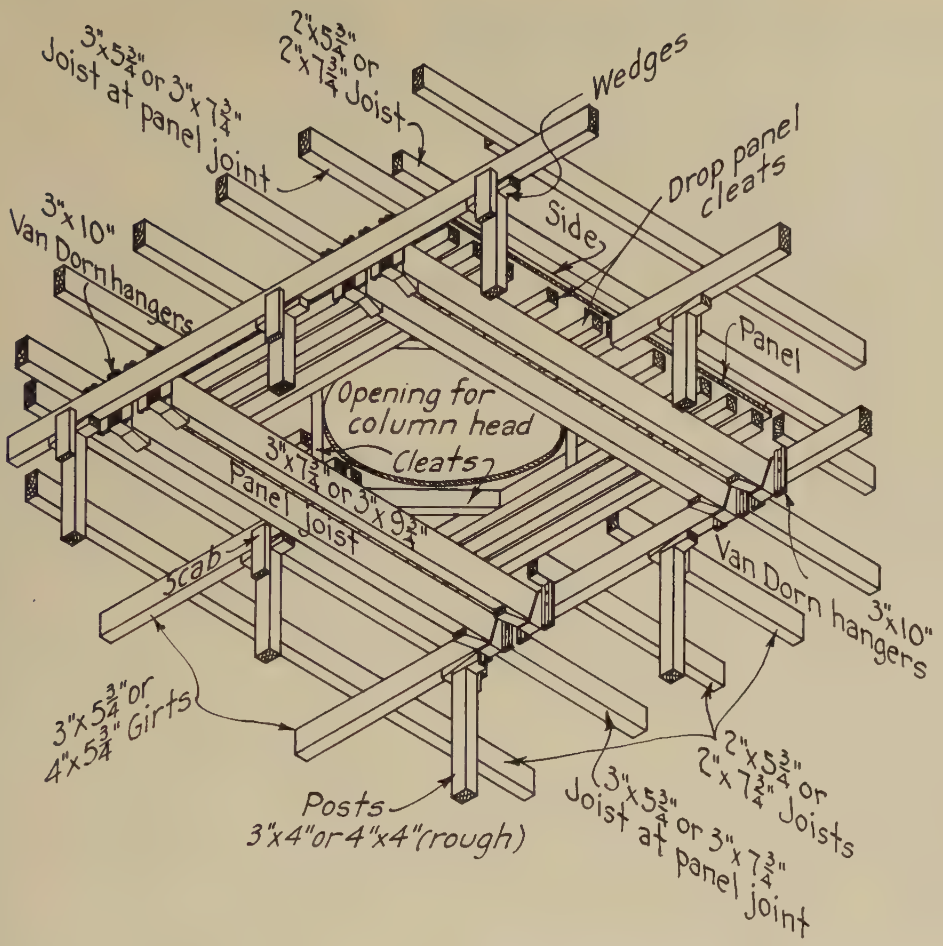


FIGURE 34 - FORMS FOR DROP PANEL (VIEWED FROM BELOW)

Note:- See FIGURES 31, 32 and 33 for details

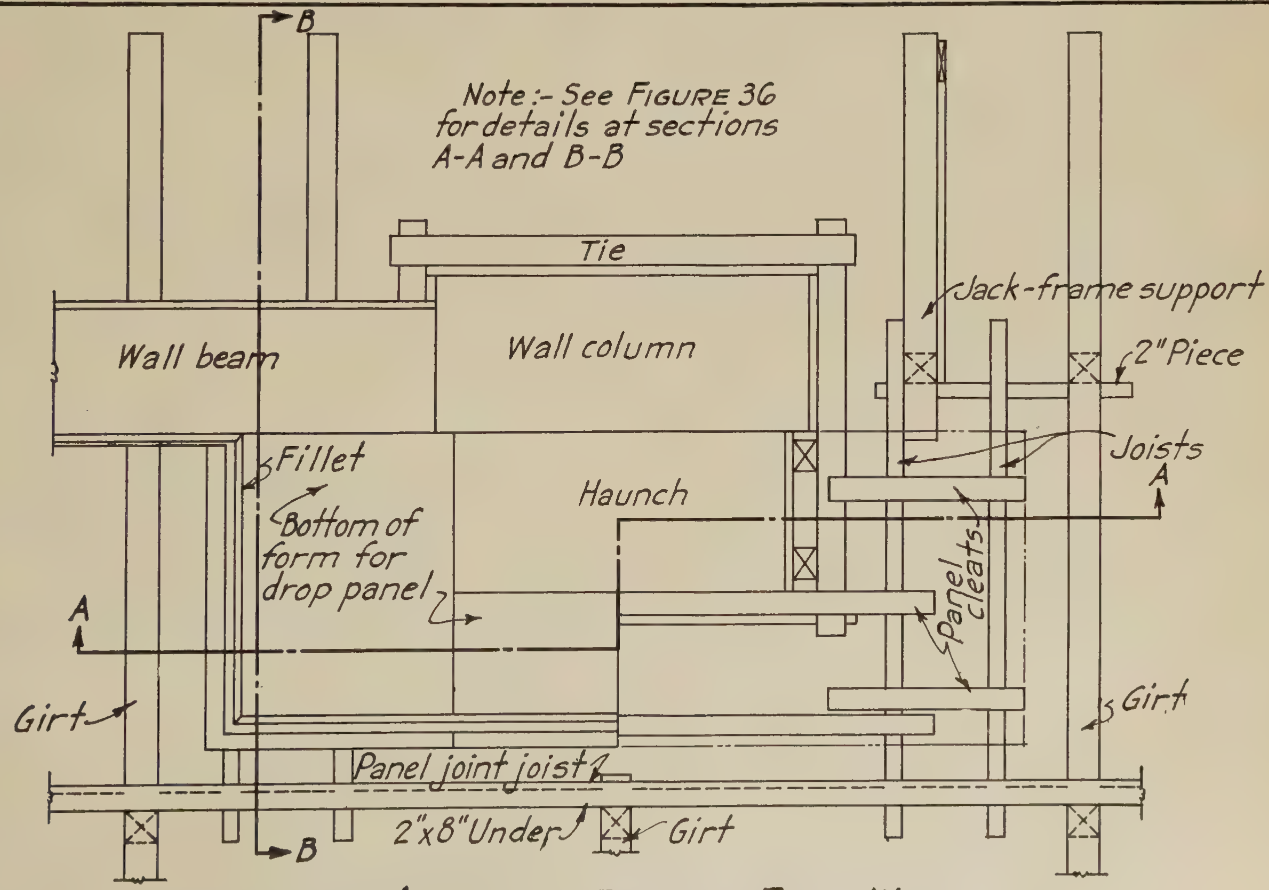

Note:- See FIGURE 36 for details at sections A-A and B-B

FIGURE 35 - ASSEMBLY PLAN OF FORM WORK FOR ONE HALF DROP PANEL AT EXTERIOR COLUMN

floor bay, also described in the article immediately preceding this one. The logical procedure to be followed in stripping is as follows:

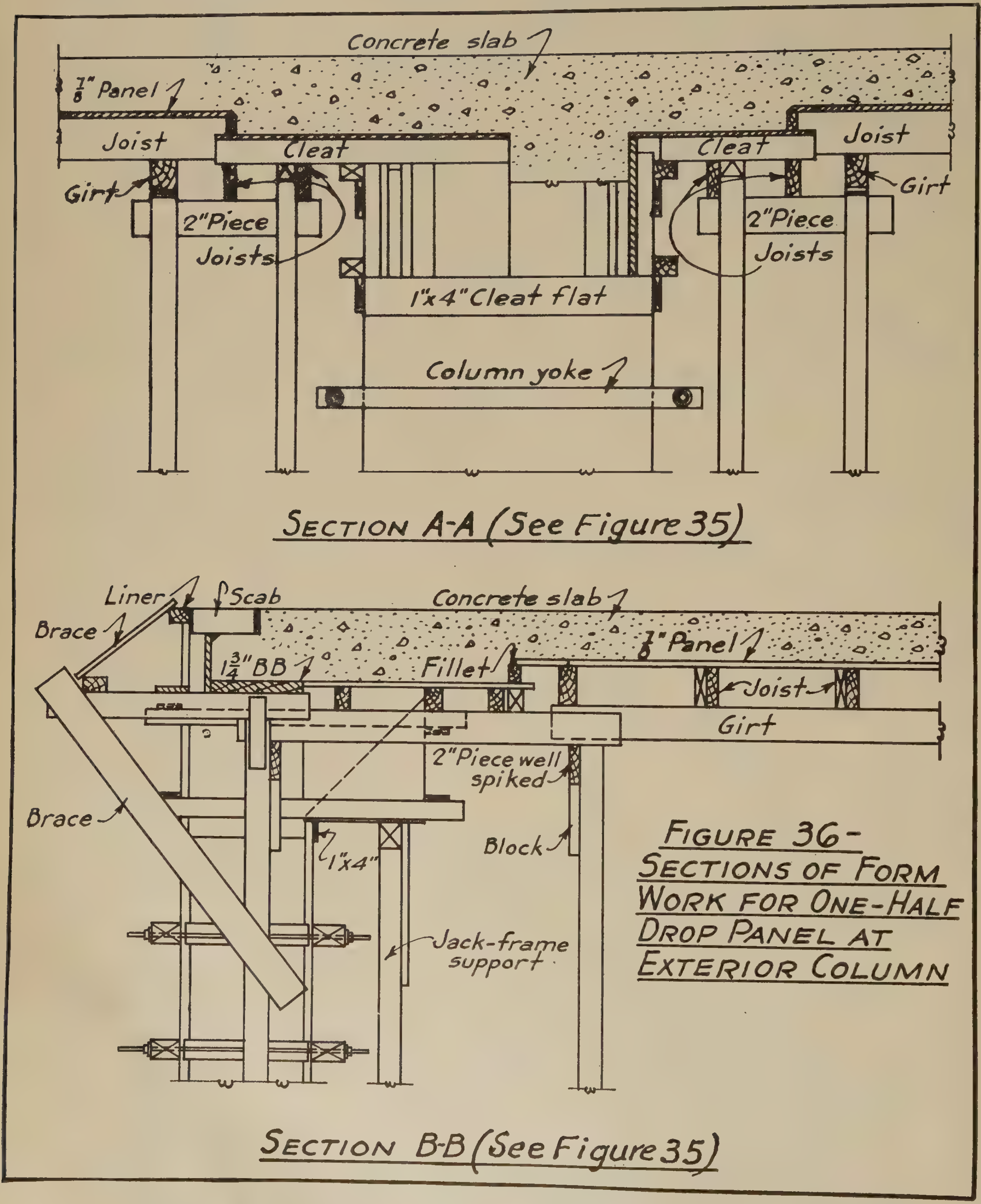
(1) Assuming that the "permanent" shores have been placed under the surrounding floor bays and that the metal forms of the column capitals have been removed, loosen the wedges between the girts and the tops of the centering posts, but do not completely remove the wedges.

(2) Remove the two joists on one side of the column by sliding them out of the hangers, and let down that half of the form panel.

(3) Repeat the foregoing operation on the other side of the column.

(4) Remove the double-headed nails which were driven through the 1-by-4 scabs into the girts, and take the girts down.

(5) Remove the 1-by-6 horizontal pieces that brace the centering posts, and take the posts down.



SECTION A-A (See Figure 35)

SECTION B-B (See Figure 35)

FIGURE 36—SECTIONS OF FORM WORK FOR ONE-HALF DROP PANEL AT EXTERIOR COLUMN

Coloring Concrete and Concrete Masonry

Increasing Importance of Color Emphasized in Report of Committee 703 of A. C. I.—Admixtures of Color Pigments and Penetration Process Are Most Commonly Used—Colors and Processes Recommended

THE increasing importance of color in daily life has made the use of colored concrete an architectural necessity. The methods of coloring concrete may be considered in three classifications: first, the integral admixture of finely divided, inert color pigments; second, the use of colored aggregates which are exposed by some treatment of the surface after the mixture has hardened; third, surface treatments which may be further subdivided into penetration treatments and cover coats such as paints. The pigment admixture method is probably the most extensively used of the various methods listed. It is used in stucco, many precast products, sidewalks, driveways and floors. The colored aggregate method has been used with conspicuous success in monumental structures and in cast stone, lighting standards, art marble and terrazzo, frequently in combination with pigments. The penetration processes have been applied to floors and tennis courts having a troweled surface. The use of paint coats on concrete is not greatly developed, though much has been accomplished in interior decoration by that means.

Coloring With Pigments

Not all pigments which can successfully be used in paints are suitable for cement colors. The requirements for cement color pigments are color durability under exposure to sunlight and weather, fine subdivision, intensity of color when finely subdivided and a chemical composition such that the pigment does not interact with the cement to the detriment of either cement or color.

These requirements are generally best met by the following types of pigments:

Iron oxides: Red, black, yellow, brown.
Manganese dioxide: Black.
Chromium oxide: Green.
Carbon pigments: Black.
Ultramarine blue: Blue.

Organic colors have not been developed for use with cement to a point where they can be considered dependable. Other colors which should be avoided are those containing Prussian blue, cadmium lithopone and zinc and lead chromates.

By the use of color pigments it is possible to obtain color effects over a fairly wide range of hues. Brilliant or intense colors are not generally attainable. Black is difficult to produce where the surface is floated or troweled as a final treatment. Some strikingly good blacks have been produced in concrete with special surface finishes. The carbon black pigments, which are most effective weight for weight, cause serious reductions in strength and are difficult to incorporate uniformly in the mix when the quantity used exceeds two or three per cent of the weight of the cement. Black iron oxide is probably the best pigment for producing black concrete, but the greater quantities necessary make the cost rather high.

There are great differences in the tinting qualities of pigments which make the question of relative economy of high priced and low priced pigments of importance to the user. A quantitative rating of tinting qualities would probably show an advantage for the better quality pigments, even though the price per pound is higher.

The quantity of pigments which may safely be used is customarily limited to about ten per cent of the weight of the cement (2 per cent for carbon black). Data have been obtained which show that these limits may be considerably exceeded without injury to strength, at least under certain conditions and with certain pigments.

An essential in the use of color pigments is that they shall be thoroughly incorporated in the mixture. Most pigments have a tendency to form soft aggregations which can be broken up only by very thorough mixing. While it is true that addition of the color pigment to the concrete at the time it is mixed can result in good distribution, there is the strong possibility that streaked and spotty color effects may be produced.

Unquestionably the best method of insuring thorough incorporation consists of premixing the cement and the color. Colored cement is made by grinding portland cement with pigment, which if properly done, insures thorough incorporation and uniformity not ordinarily obtained on the job, particularly the smaller job.

The choice of materials other than pigment depends upon the requirements of the work. For the darker or more intense colors gray cement is generally used. White cement or a mixture of white and gray cement is necessary if the more delicate tints are sought. For these latter types the use of aggregates such as silica sand and marble is advisable, since fine material in the aggregates, if of a hue different from that of the pigment used, is likely to affect the color of the mixture. The usual result is that instead of the clear color obtained with clean materials a muddy appearance is produced.

Insuring Permanence of Colors

Aggregates of color harmonizing with ground mass of colored cement paste are, of course, an essential if the finish is one which exposes the aggregate to view or if the surface film of cement is likely to be removed through the agencies of weathering.

Lack of permanence of color in a concrete surface is, in the author's opinion, less often due to deficiencies in the quality of the pigment than to other causes. Exposure of aggregate particles may result in apparent fading of the color, even though the color of the cement paste is practically unchanged. At a distance too great to distinguish individual aggregate particles, the apparent color of the mass is the resultant effect of the colors of the exposed aggregate and of the cement paste. If exposure is well advanced, the aggregate forms the greater part of the visible surface and its color will dominate. The best assurance against a possible marring of the color effect from

---

Abstracted from report by Raymond Wilson, author-chairman, of Committee 703.

this cause is the use of aggregate which, if exposed, will not result in an unharmonious appearance. The aggregate may be one of the same color as the pigmented cement paste, or it may be a colorless or white aggregate.

Efflorescence is another cause of color impermanence. A light deposit may cause the color of the concrete to appear faded or the color may be completely masked by a heavy one. The effect of efflorescence is more strongly apparent on darker or more intensely colored concrete than on a delicately tinted surface.

Coloring of concrete by penetration processes has been an attractive possibility, but the difficulties in the way of its successful application have limited its development. It has been rather extensively used on hard troweled surfaces such as floors and tennis courts. The process depends on a reaction between a constituent of the penetrant and a constituent of the concrete with the formation of a colored product in the surface pores. As an example, treatment of concrete with a ferric iron salt results in the precipitation of hydrous ferric oxide which is reddish brown in color. A fairly wide range of reds, yellows, browns, greens and grays can be produced by the salts of various metals. The variations inherent in the absorptiveness of the surface cause some non-uniformity in the color.

In practice it is customary to incorporate a fluosilicate hardener with the color-producing salt. The solution is applied to the concrete after the latter has been cured and allowed to become surface-dry. Several applications are usually made allowing time for penetration and drying between treatments. After the final application, an oil-wax treatment is applied to fix and protect the color.

Good results with this type of coloration depend on the quality of the concrete, as well as upon the maintenance of proper composition of the solution, and skill in its application. For that reason it is customary for the company which colors the floor to take the contract both for placing the wearing course and coloring it.

Discussion by Maxmilian Toch

Two things must be borne in mind in the use of pigments for cement. The one is that no pigment should be used which will basically combine with the free lime as it is generated, and secondly, no pigment must contain soluble salts which will eventually mask the color.

In the first instance, all of the copper salts and all of the lead salts are dangerous in cement work. The cadmium colors are not dangerous if used in limited quantities, and are exceedingly brilliant and permanent to light. Any color that contains calcium sulphate lowers the strength of the concrete to a remarkable degree, and as this material is soluble in water 1 to 700, it produces efflorescence in almost every case.

There are several organic pigments which give excellent results, particularly the Para, Chlor Para and Toluidine reds.

The writer agrees that the pigments should be mixed with cement by fine grinding. The best results are obtained that way.

Progress of British Concrete Research in 1929

By A. C. BLACKALL
London, England

Since the second year of the war the British Government has centralized its research activities under the Department of Scientific and Industrial Research. Various sectional boards were set up by this department, one of the most prominent being the Building Research Board. It is the opinion of this board that, although the aid of science is being invoked to an increasing extent for building operations, there is still room for a much closer liaison between science and practice. In the reports alike of the board and of the director of Building Research, the indispensable necessity for the co-operation of both the scientific and the practical sides is constantly emphasized.

During the past year an outline was given of a number of researches made with the object of throwing light on the fundamental physical changes that go on in the life history of cement and concrete. They include a variety of experiments which show that some of the characteristic phenomena of cement could be explained if it were not a definite solid but a rigid gel, the physical properties of which would vary with variations in its moisture content. These investigations continue, and are leading to results of fundamental importance. However, in regard to these and other branches of the subject, the program laid down, so far as disclosed, seems to fall short of the scale warranted by the importance of the subject.

The year 1929 showed a continuance of both the economic and the technical progress that the cement industries of Britain have been making for the past six years. During that period the consumption of cement per head of population in Britain increased by just 50 per cent, while in the previous 18 years the increase was less than 10 per cent, or about the amount of the increase in the last two years. Whatever may be the detailed explanation of these remarkable figures, they would obviously not have been possible if the properties of British cement had not come to be recognized far more than hitherto by those best qualified to appreciate them. Last year continued the experience of its predecessors, and constantly increasing uses were found for rapid-hardening cement, of which the small extra cost is found to be more than offset by its incidental advantages.

A development which was carried considerably further during the year was the manufacture of artificial stone out of chippings of natural stone crushed up with plain or colored cement or concrete. The match obtained is extremely close, and in addition to the excellent mechanical properties of the synthetic material, it costs one-third less than that of natural stone, or an even lower price.

Among important new British works in the construction of which concrete played an outstanding part last year were the extensions of the Tilbury Docks, London. This involved the use of some 40,000 tons of cement, and the project is notable for the fact that it was completed 12 months ahead of contract time. There appears to be no doubt that the contracting firm was assisted materially by the properties of the rapid-hardening cement, which apparently contractors have not yet learned to discount in their time estimates. The contract for the Shannon hydroelectric works carried out for the Irish Free State by a German firm, was completed last year. It required the use of over 67,000 tons of cement. The Southampton Dock works, estimated to use 112,000 tons of cement, was started during the year, and an important concrete road 2¼ miles long was finished from Denham to Rickmansworth.

Two interesting works in reinforced concrete were a Hangar for Heston Airport, London, and seven miles of transmission poles from Brighton to Worthing for the Central Electricity Board. These poles are 47 feet high overall, 25 inches in diameter at the bottom, and 13½ inches at the top. The design enabled the poles to be cast centrifugally, and they weigh approximately 40 per cent less than German poles of the same strength. Incidentally, their erection has shown that their natural gray color is much less conspicuous than the usual black-creosoted poles.

Reinforced Concrete Design Simplified

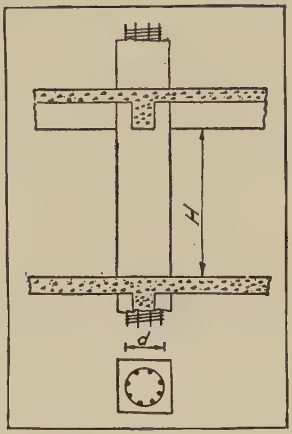
Chart N_1—Long Columns

By JAMES R. GRIFFITH
Professor of Structural Engineering, Oregon State Agricultural College

American Concrete Institute Building Code

$P'/P = 1.50 - h/100R$

h/R more than 50



THE Building Code of the American Concrete Institute is more liberal toward spiral reinforced columns than the Joint Committee Specifications. The A. C. I. Code does not require long column design unless the ratio of h/R is greater than 50. The Joint Committee Specification puts a ratio of 40 as a limit.

The general method of figuring long columns by the A. C. I. Code is similar to that used under the Joint Committee Specification. Thus the allowable load is reduced, depending for its magnitude upon the ratio of h/R. The formula specified is

$$P'/P = 1.50 - \frac{h}{100\,R} \qquad \text{Eq. 1-N}_1$$

h is the unsupported column height in inches,

R is the least radius of gyration of the column core.

In the original series, under Chart N, a problem was assumed:

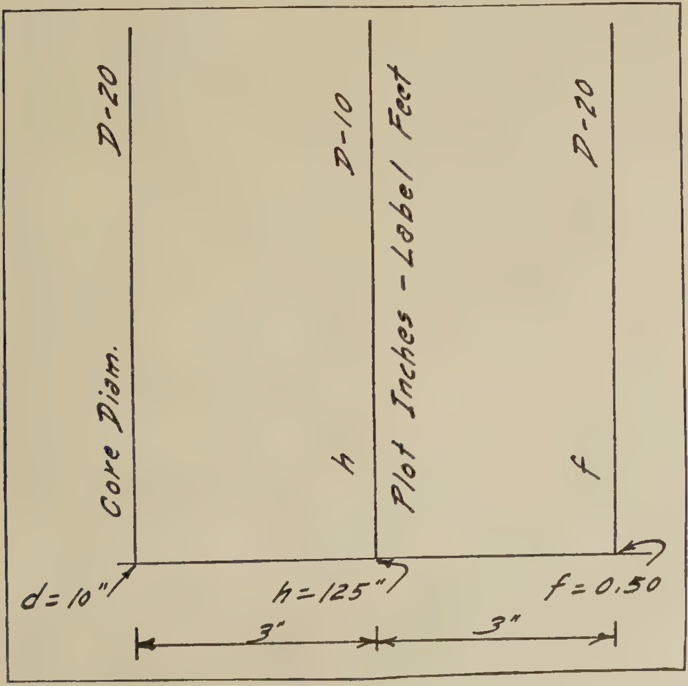


Figure 1-N_1

TABLE 1-N_1

P'/P	$f = (1.50 - P'/P)$
0.10	1.40
0.15	1.35
0.20	1.30
0.25	1.25
0.30	1.20
0.35	1.15
0.40	1.10
0.45	1.05
0.50	1.00
0.55	0.95
0.60	0.90
0.65	0.85
0.70	0.80
0.75	0.75
0.80	0.70
0.85	0.65
0.90	0.60
0.95	0.55
1.00	0.50

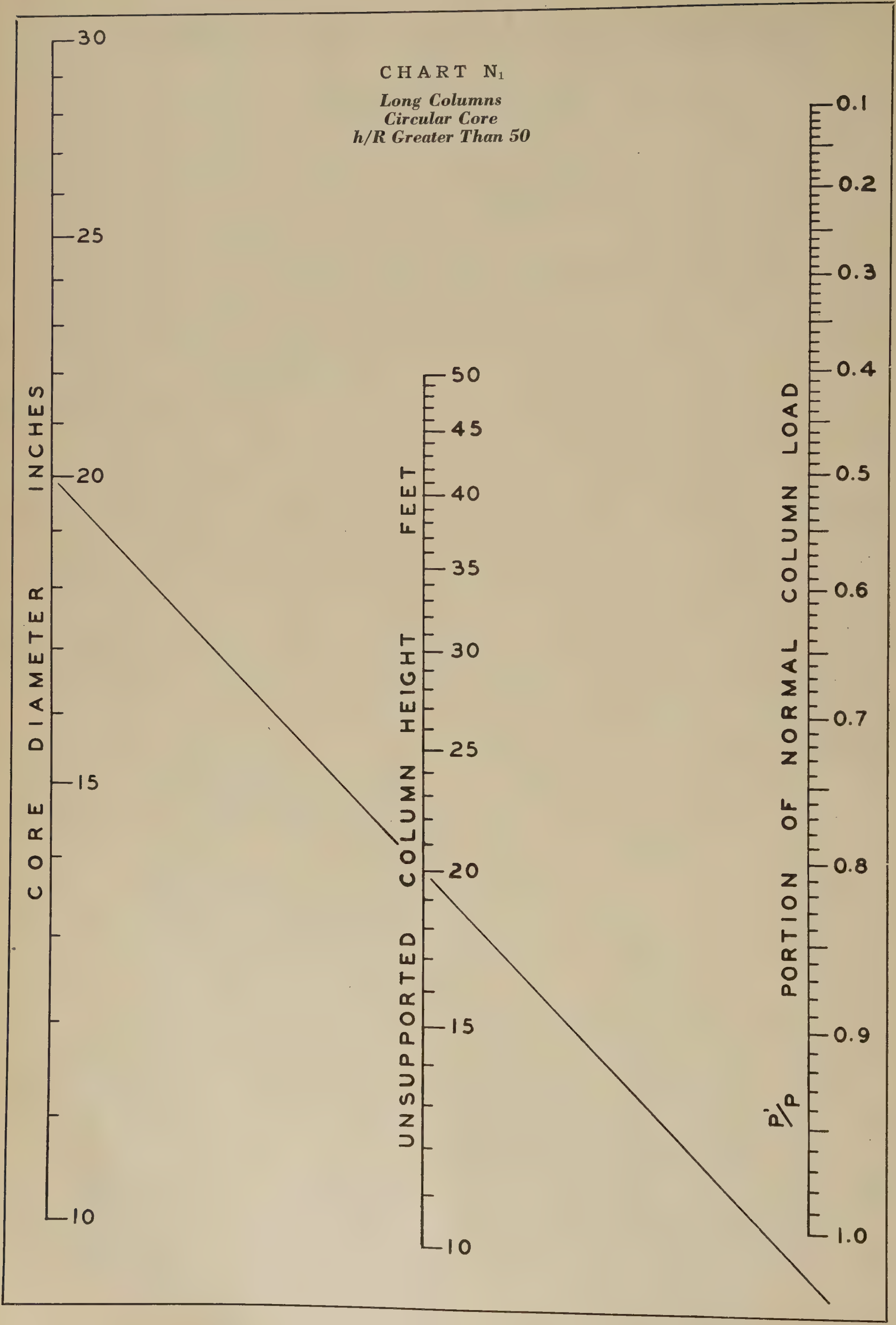


CHART N_1

Long Columns
Circular Core
h/R Greater Than 50

Core diameter = 20 in.

Unsupported height of column = 20 ft.

Under the Joint Committee Specifications, a permissible ratio of

$$P'/P = 0.93$$

was found. On Chart N_1 the solution isopleth indicates that for these same assumed conditions, a full column load is permissible. So the ratio of h/R must be less than 50.

$$h/R = \frac{20 \times 12}{20/4} = 48$$

Construction of Chart N_1

Eq. 1-N_1 is of similar form to that used in the plotting of Chart N of the original series. As the exponents of the variables are identical, the spacing and relative sizes of scales will be the same.

Transforming Eq. 1-N_1 to the form

$$h = 25\,d\,(1.50 - P'/P)$$

and letting

$$f = (1.50 - P'/P)$$

I then prepared a table, given on the first page of this article, showing values of P'/P and their corresponding values of (f).

Assuming the construction isopleth as passing through the values of

$$d = 10 \text{ in.}$$

$$P'/P = 1.0, \text{ or } f = 0.50$$

I find a value of

$$h = 125 \text{ in.} = 10.4 \text{ ft.}$$

Values of (f) were plotted from Table 1-N_1, but labeled their corresponding value of P'/P.

The complete information by which the original of Chart N_1 was plotted is shown in Fig. 1-N_1.

The Concrete Masonry Industry Is Going Ahead

New National Organization to Undertake Educational and Research Work—Manufacturers Urged to Support Proposed Activities

The First of Several Short Talks with the Products Manufacturer

THE Concrete Masonry Association has stepped forward to take the place long occupied by the National Concrete Products Association. On its face this may appear to be merely a change in name, voted by the board of directors; but let no one assume that there is nothing more substantial back of the change.

The doom of the National Concrete Products Association was sealed at the New Orleans convention, held back in February, the day preceding the opening of the American Concrete Institute's annual meeting. Only a handful of delegates appeared and only a third of those were concrete products manufacturers.

This small attendance gave every one both a chance and a cause to speak, and most of the speakers expressed themselves freely and frankly. All were agreed that the National Concrete Products Association had failed to win prestige or to attract membership because it had never undertaken large-scale activities of nation-wide interest to the industry.

A new name for the association was suggested at the New Orleans meeting not for the sake of changing but because of the belief that the new and far-reaching activities proposed for the industry should not be associated with the name of an organization that had so little of previous accomplishment to its credit.

The annual dues have been increased to $100.00 for the largest plants, designated as Class A (producing more than 500,000 units annually). Class B plants are to pay $50.00, while dues for Class C plants and associate members are $35.00. This schedule of dues, though it appears to be rather low, is a great improvement over the former nominal dues.

The program of the new Concrete Masonry Association includes educational and research work of national importance. We predict that when the membership is built up it will be found to include only the stronger plants of a community—strong from the financial and management standpoints.

It will be well if this prediction comes true, for undoubtedly the salvation of the industry lies in its ability to cut loose from the irresponsible, price-cutting element that is in business one year and out the next, only to be replaced by others of the same breed. Partly through mergers and partly through the more painful process of business mortality, the incompetents must be eliminated if the industry is to flourish.

Even if only a few hundred of the larger companies were to give financial support to the association, the larger dues now established will create a fund sufficient to carry on the most important of the proposed activities. Such a group will be financially able to do things in a big way. Through diversification of products, better sales methods, co-operative advertising and other modern methods of business, the competition of other strongly organized masonry materials can be met. New fields for concrete masonry units can be developed. These developments have in fact been in the making for several years.

All this does not mean that the little fellow is to be frozen out—not if the little fellow is big enough to fit his market, if he diversifies his products, and if he has ample working capital and managing ability to develop his market. The little fellow who is competent will in due time grow up to the size of the community in which he operates.

INFORMATION and CONSULTATION

THE HOW-TO-DO-IT DEPARTMENT

These columns are devoted to helping readers solve their problems in all phases of concrete work. Inquiries are invited. Where readers can add to or improve upon the suggestions printed, in answer to inquiries from others, they are also welcome to submit their views for possible publication.

Design of Flat Slabs Under Concentrated Loads

Referring to the "Formulas for Design of Flat Slabs Under Concentrated Loads," mentioned on Page 26 of your April issue, can you tell me where copies of that publication may be obtained?—J. S. G., Manchester, England.

The exact title of the report there mentioned is "Girderless Flat Slabs for Railroad Locomotive Loadings." It comprises the first four pages of a pamphlet entitled "Report of the Committee on Masonry," published by the American Railway Engineering Association, 59 East Van Buren Street, Chicago. Copies of the pamphlet may be obtained at 50 cents each.

The method of design given is applicable also to the design of highway bridges of the reinforced concrete flat-slab type.

Electric Floating Machine

We are interested in various methods of finishing concrete surfaces. At present we are using, along with the standard troweling method, the pea gravel displacement method, which is quite satisfactory. However, we understand there is an electric-driven floating machine on the market. Can you furnish us the name of the manufacturer?—I. S. D., Los Angeles, Calif.

Several companies manufacture electric-driven floating and polishing equipment for finishing concrete surfaces. A list of such manufacturers has been sent.

Fire-Resistive Rating for Concrete Block

I manufacture hollow cinder concrete units. Where can I get information for a local architect regarding the underwriters' fire-resistive rating of this material?—F. C. B., Rockford, Ill.

The information you want is printed on Page 4 of the "List of Inspected Fire Protection Appliances" dated July 1, 1929, and issued by the National Board of Fire Underwriters, 85 John St., New York. Copies may be obtained by addressing that organization.

Crazing of Cast Stone

How can I overcome the trouble I am having with surface crazing in cast stone?—R. J. B., Buffalo, N. Y.

One manufacturer of cast stone who is doing a large volume of business had similar trouble up to about two years ago, when he overcame the tendency toward crazing. Since then he has had no difficulty.

This manufacturer eliminated the trouble in part by using a leaner mixture. He now holds to the proportions of 1 to 3.

He made further improvement by discontinuing the use of extremely fine sand. In general, he now uses no sand that passes a 30-mesh screen.

Practically all the cast stone made by this manufacturer is finished with an acid wash.

Mixture for Concrete Lot Markers

I have been making concrete lot markers for a memorial park, and for the part of the marker above ground I have been using white cement and about half as much lime as cement, by measure. The concrete does not harden as much as it should, and the markers become chipped and scratched where the lawn-mower hits them. How can this be remedied?—G. E. M., Willow, Mich.

It is probable that for the severe climate of Michigan you are not using the right mixture. For the part of the marker above ground you might try one part of white cement, from 1½ to 2 parts of sand, from 3 to 3½ parts of coarse material, and about 6 gallons of water to the sack of cement. It is best to experiment a little with the mixture, so as to get the proper proportion between the fine and coarse material. In general, you will probably find that the quantity of sand should be a little more than half the quantity of coarse aggregate to give you a satisfactory mixture.

For the part of the marker below ground, you can use about the same proportions, but with ordinary portland cement. This mixture may cause a slight increase in the cost of the markers, but it will be far better to make up this difference by charging more for them than to put out a marker that is not giving satisfactory service.

Design of Large Concrete Tanks

Have you published any articles on the subject of design of large concrete tanks, from 75 to 100 ft. in diameter?—E. C. F., New York City.

You will find this subject treated in a thorough but condensed form in an article by W. W. Hay on Page 43 of the June, 1928, issue of CONCRETE. Mr. Hay's article covers tanks of any height or diameter.

Sidewalk Finishing Equipment

Is there any machine on the market that spreads, tamps, and finishes concrete in sidewalks, in a manner similar to concrete road finishing equipment?—A. J. P., New Orleans, La.

We are not familiar with any equipment of this nature at present on the market. If any readers know of such devices we should like to hear from them.

How to Make and Place Concrete Flagstone Pavements

Walks and Driveways of Precast Flags or Units Cast in Place Becoming Popular Around Homes and in Parks—Construction Information for Concrete Builders

FLAGSTONE pavements—walks and driveways—are becoming tremendously popular around homes, in public parks, and in recreation centers. In fact, many contractors report considerable success in selling this type of concrete work. Flagstone walks and driveways are simple to build and easy to sell. In general, there are two main types—concrete units cast in place, and units precast in forms in the contractor's yard or on the job.

In building flagstone pavements it is well to prepare a typical pattern in which each flag is shown and its size is determined. Although there is no limit to the number of sizes and shapes of units that can be worked into a design, three to seven sizes will permit as much flexibility as is ever needed. The design in Plate 1 required only five sizes, and these can be arranged in many different patterns.

To determine the sizes shown in Plate 1, a section of walk, 2 ft. wide and 8 ft. long, was first laid out. This was then broken up into a pattern requiring five sizes. The pattern is repeated every 8 ft. in both the four-foot and eight-foot widths.

Thickness of Units

The thickness of flags depends upon the method of laying, and the traffic the walk or drive will carry. Where a level surface is desired or where the pavement will be subjected to heavy traffic, as in a driveway, a concrete base, 4 to 6 in. thick, is recommended. In this event, the flagstones are made 2 in. thick. Where it makes little difference if the walk is uneven—an effort often desired in landscaping—the units are laid directly upon the earth, and are made 4 in. thick.

Walk of concrete flagstones in Santa Barbara, California

Stepping stones of concrete. Note the concrete retaining wall at the left

Forms for casting flagstones consist of a framework of wood or metal, 2 to 4 in. high, depending upon the thickness of the units. Some contractors prefer metal forms because they can be taken apart easily and usually give longer service. Forms can be made so that a number of different sized flags are cast in one operation. For example, sizes A, B and C in Plate 1 could be made in a form 13½ in. wide and 22½ in. long, inside, with ½-in. dividers. Another form, 11½ in. wide, and 19½ in. long, could be used for casting two each of sizes D and E, the dividers being ½-in. wide.

Some contractors use a form in which several flags of the same size are made at once. These are known as "gang molds." In casting the units the form is laid on a smooth, flat, well-oiled platform. Form faces coming in contact with the concrete likewise are oiled.

The Concrete Mixture

The concrete mixture for flagstone is one containing not more than 5½ gallons of water per sack of cement if the aggregates are perfectly dry. If the aggregates are moist, only 4¼ gallons of water per sack of cement are used; if dripping wet, only 3¾ gallons. It is very important that the water be kept within the amounts specified, since the wearing quality of the concrete is controlled by the ratio of water to cement.

Satisfactory concrete can be made by using 2 parts of sand and 3 parts of coarse aggregates (not exceeding ¾ of an inch in size) to each sack of cement (1:2:3 mix). If this mixture is too wet, when the recommended quantity of mixing water is used, more sand and coarse aggregates are added; if too stiff, less aggregate is used in the next batch.

Note: (100 sq. ft. of flagstone, 4-in. thick, will require 9 sacks of cement, 17½ cu. ft. of sand and 26 cu. ft. of gravel or crushed stone. These amounts may vary somewhat, depending upon the nature of the aggregates. No allowance is made for waste.

Colored Flagstones

If colored flagstones are desired, they may be made by mixing a small amount of mineral pigment with the concrete. Two precautions must be observed. First, only the highest quality of mineral oxide pigments should be used; second, the amount of pigment used should never exceed 10 per cent of the weight of the cement. More than this amount may weaken the concrete. From 2 to 5 per cent of color pigment will give light shades; 5 to 10 per cent, deep colors. These are only general recommendations, and, in every case, manufacturers' instructions should be closely followed.

Depositing the Concrete

When the concrete is deposited, it is worked with a trowel or similar tool so that all corners of the forms are filled, and leveled off with a strikeboard. Before the concrete hardens it is finished with a wood float, producing a smooth but gritty surface. The flags may be removed from the forms about 48 hours later and moist-cured for at least 7 days before being used. A convenient method of curing is to cover the units with burlap or sand, keeping the covering constantly moist during the 7-day period.

Laying Precast Flagstones

Flagstone walks can be laid with or without a concrete base, depending upon the service required. It is recommended that all driveways be constructed with a base.

In laying the flagstone pavement on a base, make an excavation the length and width of the walk or driveway, the depth being 2 in. (the thickness of the units) plus whatever thickness of base is required. For driveways, a base 4 to 6 in. thick is recommended; for sidewalks, 3 to 4 in. thick. The side walls of the excavation should be straight and sharp with the bottom as level as possible.

The concrete mixture for the base is the same as that used for the units; that is, a 1:2:3 mix containing not more than 5½ gallons of water per sack of cement if the aggregates are dry.

The full thickness of the concrete base is placed in one operation and leveled off with a strikeboard so that it is of uniform thickness. If the driveway or walk is quite long it is recommended that sections about 8 ft. long be built at a time.

To cement the flagstone units firmly to the base, place them in position as soon as possible, and not longer than 45 minutes after placing the base. A mortar bed, ¾ to 1 in. thick, is spread over the freshly placed concrete, mixing the mortar in the proportions of 1 sack of cement to 3 cu. ft. of coarse sand, with only enough water to make it plastic. If colored joints between the units are desired, mix mineral pigments with the mortar in the same proportions as specified for colored flags. Immediately after the mortar bed is placed, set the units in position according to the predetermined pattern, being careful to allow the required spaces between them. Flagstones should be pushed firmly into the mortar bed. The ends of each 8-ft. section are staggered so that the next section will fit in without a continuous joint across the pavement (see Plate 1). When the units for one 8-ft. section are placed leveled, and the joints screeded, the next section is built. The pavement is cured for at least a week before it is used. Contractors have found that the best method is to cover the pavement with damp sand, wetting down this covering each day.

Where 4-in. flagstones are laid without a concrete base, the excavation is made only 4 in. deep. No mortar bed is required, but spaces between flags usually are filled with dirt and later seeded so that grass will grow between the units.

Casting Flagstones in Place

Flagstone walks are frequently cast in place, this method being economical when the job is of considerable size and is a considerable distance from the yard.

When casting flagstones in place an excavation of the proper dimensions is made, the depth depending upon the service to which the pavement will be subjected; if a driveway, the depth is from 6 to 8 in. to provide for a base; if a sidewalk, 4 to 5 in. will be sufficient.

The procedure from this point on may follow any one of the following three methods:

1. All form work can be built in the excavation, the depth of forms being the full thickness of the pavement. The spaces between the flagstones can extend through the full thickness of the pavement and later are filled with dirt and seeded for grass.

2. Concrete for the full thickness of the pavement is placed. Dividers or forms for the various units are then pushed into the freshly placed concrete, depending upon the concrete to hold them in place. The concrete is then leveled off and finished with a wood float. The dividers usually are about two inches deep, so that spaces between the units do not extend through the entire thickness of the pavement. The advantage of this method is that the flags are cast integrally with the base. It is used principally for driveways. The method is also quite frequently used where no special pattern of flagstones is desired, the dividers being inserted at random and in any direction. This, of course, can be accomplished with forms set in place before concreting begins, but considerably more form work is required. A disadvantage of the method is that spaces between the units are not deep enough to hold sufficient dirt for a good growth of grass.

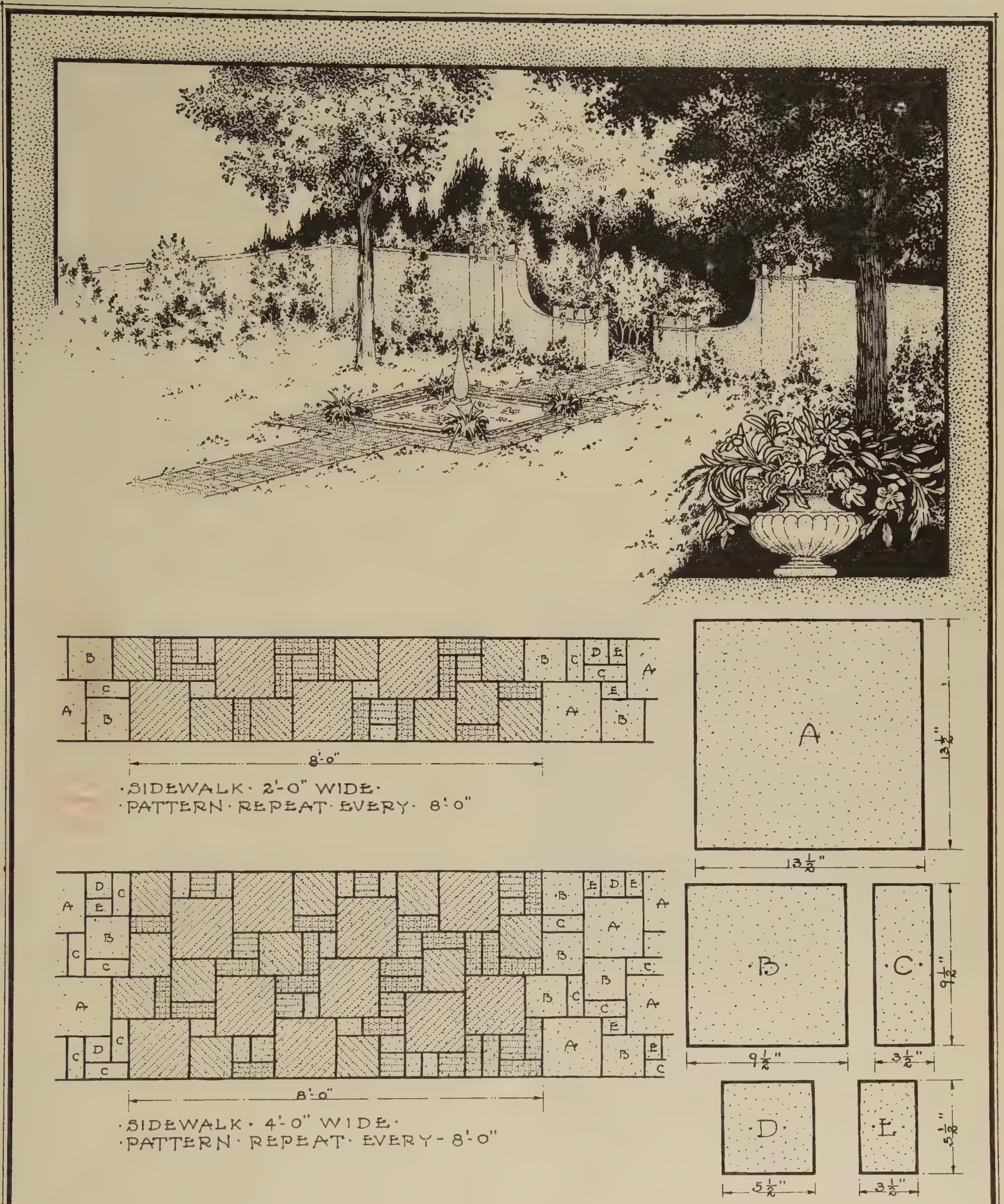


PLATE 1. CONCRETE WALKS BUILT OF PRECAST FLAGSTONES. FIVE SIZES ARE REQUIRED FOR THIS ATTRACTIVE PATTERN

3. This method accomplishes the same end as the second method—that is, casting a base integral with the flags. The form construction used is the same as in the first method. If the pavement is to be 8 in. thick, for example, the forms for casting the units are made only 2 or 3 in. high, their top edges being level with the top of the pavement. The full thickness of the concrete is placed in one operation, the bottom 6 in. being cast integrally with the top 2 or 3 in. of flagging.

Any one of these three methods is satisfactory. The choice of the one to be used will depend on the character of the job and the contractor's equipment and help.

Forms for Casting in Place

Forms for casting flagstones in place must always be beveled so as to be about one-fourth of an inch narrower at the bottom than at the top, to permit removal without breaking the edges of the concrete. They should be well oiled. Thickness of form lumber will depend upon the size of spaces which are required between units. Side forms, built of 2-in. lumber, are needed. Forms used in Methods 1 and 3 must not be nailed firmly together, but should be toe-nailed to each other through the top edges.

Recommended Concrete Mixture

The concrete mixture for flagstone pavements cast in place should be the same as for precast units and for bases—that is, a 1:2:3 mix containing not more than 5½ gallons of water per sack of cement when aggregates are dry. The full thickness of the concrete is placed in one operation and spaded against the form faces. It is leveled off across the top with a strikeboard and finished with a wood float. Forms may be removed about 48 hours after placing the concrete. The walk should then be moist-cured for 7 days, as previously described.

Concrete driveway built of precast flags. This drive matches the landscape scheme and the architecture of the house

Stepping Stones

Stepping stones usually are cast in place. Inasmuch as a rugged appearance is a desired characteristic, it is not necessary to strive for sharp and straight edges. To make stepping stones, holes approximately 4 in. deep and at least 1½ sq. ft. in area and of irregular dimensions are dug in the ground at intervals of approximately 24 in. center to center. The holes are filled with concrete, leveled off and allowed to harden.

Flagstone pavements offer a profitable market which contractors can develop with little difficulty. The average home owner is continually looking for some way to improve the appearance of his home surroundings. Flagstone pavements will do it.

Many contractors keep a supply of several sizes of units constantly on hand, making the units when other work is not pressing. They likewise have a number of typical patterns available which they can show to prospective customers.

Exceptionally attractive concrete colored flagstones of rough texture around the entranceway of a home

---

How to Clean Garage Floors and Concrete Drives

There is a comparatively simple method for cleaning garage floors and concrete drives at oil stations. From time to time concrete builders may be asked by their present and sometimes by their prospective customers how such cleaning can be accomplished.

Concrete floors and driveways where oil drippings have collected are successfully cleaned and renovated by the use of portland cement as follows:

All excess oil is wiped off the surface of the concrete or it may be scrubbed quite clean, first using a little kerosene or gasoline to cut the oily deposit. A little vigorous scrubbing with a stiff brush removes most of this oil. The surface is then thoroughly flushed with a hose stream of clean water and kept wet for about ten minutes. While the pavement is still moist, dry portland cement is dusted over it. An ordinary flour sifter may be used for this purpose. The whole surface is then swept with a fine broom. On drying, this leaves the pavement white and covers up stains which cannot be cleaned off completely. Some stations prefer to do this just before closing, so that the cement may harden over night. Other stations do it early in the morning.

Sidewalks Along Highway Movement Promoted by Society

The American Society for Municipal Improvements has undertaken a campaign to promote sidewalks along highways. This is chiefly a safety measure, though also a matter of convenience and is particularly applicable to built-up sections or sections adjacent thereto. There is no doubt that sidewalks should be provided on at least one side of many of the roads leading into cities and towns.

Aggregates for Concrete

Pebbles or crushed stone to be used in a concrete mixture should be tough, fairly hard and free from dust, loam, clay and vegetable matter. Stone containing a considerable quantity of soft, flat or elongated particles should not be used.

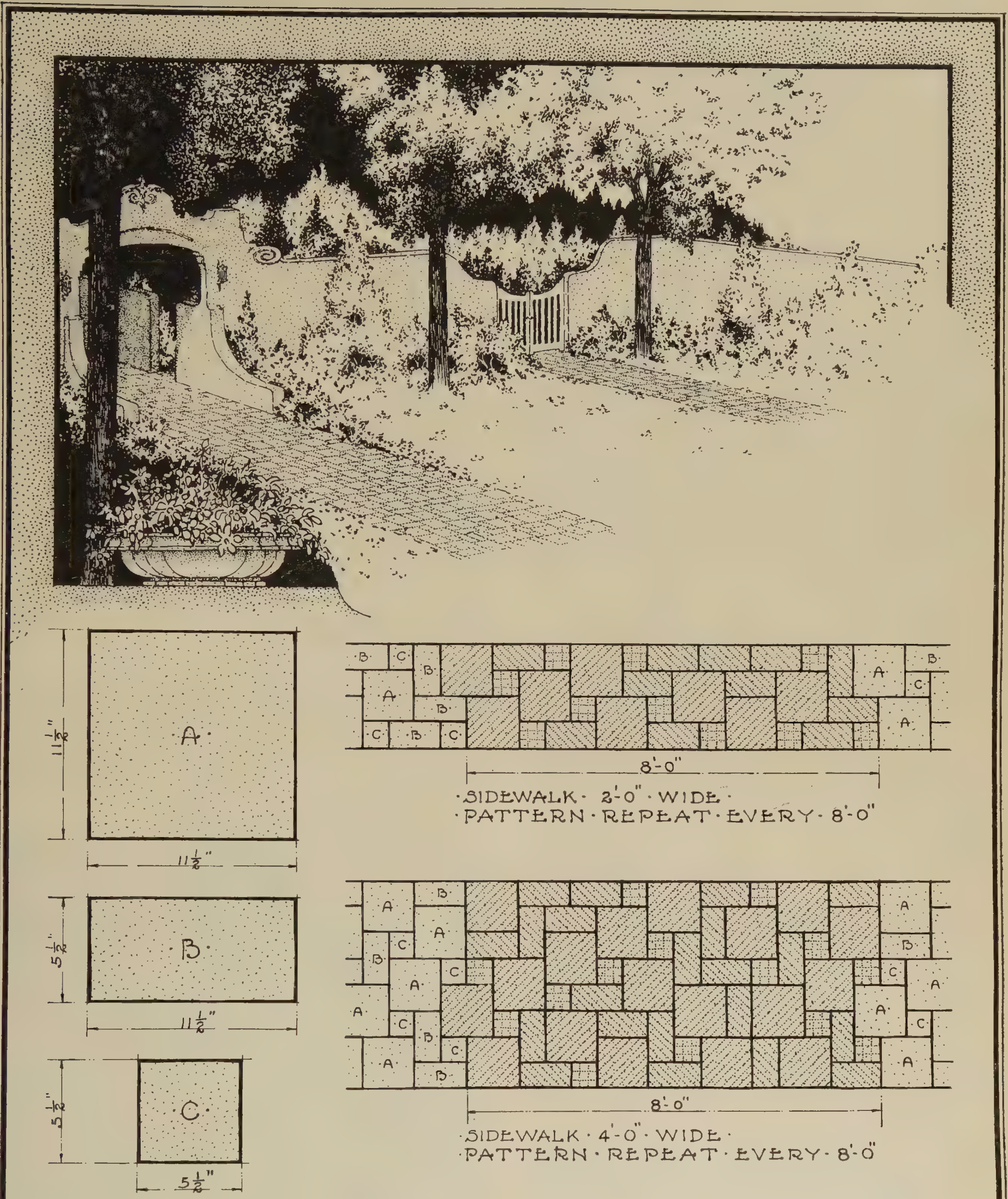


PLATE 2. A DESIGN FOR FLAGSTONE WALKS IN WHICH THREE SIZES OF CONCRETE UNITS ARE REQUIRED

Using Cracks as Expansion Joints

By **DAVID GRAHAM**
White Plains, N. Y.

CONCRETE structures are sometimes built without expansion joints or temperature and shrinkage reinforcement, although these features of construction would have contributed greatly to the success of the job. This was the case when my crew built a small concrete dam in Yorktown, New York, several years ago.

A concrete dam, 200 feet long with an average height of 12 feet, was built on rock bottom, its purpose being to create a sixty-acre lake of an average depth of 9 feet. Despite my objections to the specifications, which did not require expansion joints or temperature and shrinkage reinforcing rods, we were ordered to go ahead and build the dam.

Construction conditions were perfect, as there was very little water in the stream that fed the proposed lake and the adjoining land was comparatively dry. Construction work started in July, 1926, and the last concrete was placed in October of the same year. We had ideal concrete weather, although care was required to protect the last concrete while it cured during cold weather. The concrete mix used consisted of one part portland cement, two parts of fine aggregate and five parts of coarse aggregate. The dam was built as shown in the accompanying cross section, Fig. 1, the upstream face of the concrete being painted with asphalt.

Before the job was completed, I noticed a hair check which I thought might increase in size as the weather grew colder and when the water rose in the lake. This crack did increase in size, and two others developed during the winter before water collected behind the dam. These cracks appeared at 50-foot intervals and extended through the dam from the base to the top, varying from ⅛-inch at the bottom to ¼-inch at the top. The character of these cracks is shown in Fig. 2. Expansion joints, of course, would have prevented these cracks.

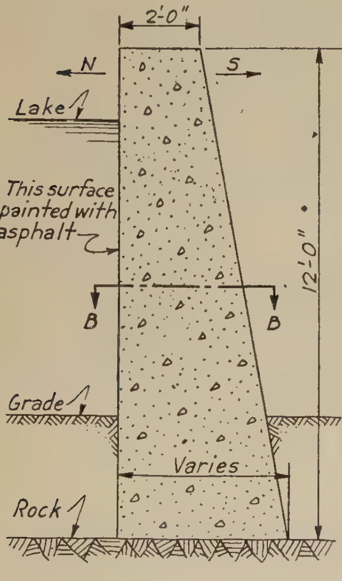


Fig. 1. Cross section of concrete dam, 200 ft. long with average height of 12 ft. Shortly after the dam was built, three vertical cracks formed at 50-ft intervals

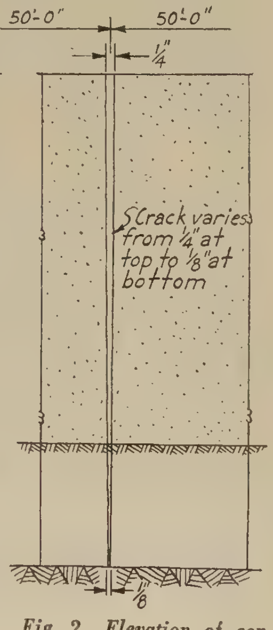


Fig. 2. Elevation of concrete dam showing character of cracks that developed because provision was not made for expansion and contraction

I was called upon to remedy the cracking. Fortunately, there was but little water on the upstream side of the dam, enabling our crew to repair the dam quickly and inexpensively. In short, we decided to make the cracks act as expansion joints.

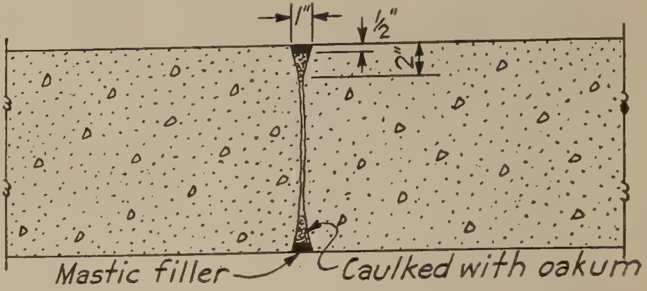


Fig. 3. Section B-B, showing how cracks were converted into expansion joints which are now serving to prevent additional cracking

To get maximum contraction for our work, we waited until the weather was very cold. I had sufficient men on the job to do the work in the shortest possible time. First, they made a V-shaped cut on both sides of the wall from top to bottom of each crack. This cut was about 2 inches deep and 1-inch wide on the face of the wall. Using fine caulking tools, each cut was packed with oakum to within ½-inch of the face of the wall. Then, using pointed trowels, the men applied asphalt mastic to each cut, bringing it up flush with the surface as shown in Fig. 3. The entire job was completed in six hours, at a very small cost.

The job was quite successful. These cracks have been acting as expansion joints for longer than three years and there is no additional cracking apparent at this time.

Windowless Concrete Building Houses Steam Heating Plant

The Pacific Gas & Electric Company operates a steam heating plant in the downtown section in San Francisco which is housed in a reinforced concrete structure without windows, all light and ventilation entering through skylights. The absence of windows keeps heating plant noises from disturbing other buildings nearby and at the same time protects the heating equipment from damage in case of fire in the surrounding buildings. The roof is also of reinforced concrete.

Solving the Builder's Problems

Conferences with Contractors Draw Out Their Difficulties—Answers to Same of Questions Asked—Water-Tight Foundations, Heavy-Duty Floors, Prevention of Dusting, Use of Decorative Paints, and Resilient Floor Coverings Are Subjects Most Frequently Discussed

By G. F. STEIGERWALT

DURING the past winter the writer was one of several men assigned by the Portland Cement Association to conduct a number of conferences with concrete contractors, arranged in the form of evening meetings.

These conferences had several purposes. One purpose was that of pointing out ways in which the concrete builder might increase his business through the application of sales methods. Another purpose was that of explaining the making of good concrete and the methods to be followed to obtain good workmanship.

In every meeting some time was allotted to general discussion, and during these discussions many of the builder's problems were brought to light. Some of the questions were raised in almost identical form in so many different meetings that they must be regarded as typical problems that confront the concrete builder. It is these oft-repeated questions that will be discussed in this article.

Water-Tight Foundations

For example, a builder brought up the following subject during the discussion which followed one of these concrete contractor conferences: "What mixture is recommended for water-tight foundations?"

Briefly, the reply was that "the recommended mix for water-tight foundations is one containing not over 6½ gals. of water per sack of cement. Use a trial batch containing 2½ cu. ft. of sand and 3½ cu. ft. of gravel of crushed stone. If aggregates are moist, use only 5 gals. of water; if they are wet, use only 4½ gals. Proportions of aggregates may be varied to give a workable mix, one which can be placed readily in the forms without separation of ingredients. This means there should be sufficient cement-sand mortar to give smooth surfaces, free from honeycombing. To insure water-tightness, sometimes two or more coats of 1:3 portland cement mortar are applied to the outside surface as soon as the forms are removed."

Heavy-Duty Concrete Floors

Another contractor, who had been building heavy duty concrete floors, was faced with the problem of choosing the correct aggregates for this kind of work. He asked: "What material should be used to obtain a durable wearing surface?"

"Aggregates of sufficient toughness and hardness," he was told, "should be selected. Trap rock of a dense, fine grained and inter-locking crystalline structure is an excellent aggregate for severe service. Hard, fine grained granites and quartzites are also suitable. For floors of a decorative nature, or where the duty imposed is not severe, aggregates of less hardness may be used. Elongated or thin plate-like fragments should never be used. All aggregates should be clean, free from dust or highly weathered fragments, and should consist of particles which will not alter in physical or chemical nature in the presence of moisture. Sand should range from zero to ¼ in. in size, with not more than 5 per cent passing a 100-mesh sieve, and not more than 10 per cent passing a 50-mesh sieve. Coarse aggregate should be well graded pea gravel or crushed stone, particles ranging in size from ⅛ to ⅜ of an inch; that is, all material passing a ½-in. sieve.

"The water should be carefully controlled so that not more than 4½ to 5 gals. of water per sack of cement are used. Moisture in the aggregates should be carefully determined and this amount subtracted from the mixing water. Experience has shown that with the use of properly graded aggregates, the proportions of 1:1:1½ to 1:1:2 will give satisfactory results when mixed with not more than 4½ to 5 gals. of water. It is recommended that curing be continued over a period of at least a week to ten days, beginning as soon as possible after the surface is sufficiently hard so that it will not be marred. Proper curing will help produce a surface that is hard, dense and strong."

Surface Checking on Floors

Having built a concrete floor according to what he believed to be recommended practice, another concrete builder was "up against it" because this floor had a tendency to hair check. He asked: "What causes fine surface checking on floors and how can it be corrected?"

In reply, his informant said: "The durability and effectiveness of a floor finish depends primarily upon the observance of the fundamental rules for making, placing, finishing and curing concrete. To prevent surface checking, it is necessary to observe the following directions for finishing and curing:

"After striking off the wearing course to the established grade, it shall be compacted with a wood float. Floating shall be followed by steel troweling after the concrete has hardened sufficiently to prevent excess fine material from working to the surface. Dry cement or a mixture of dry cement and sand shall not be sprinkled directly on the surface of the wearing course to absorb moisture or to stiffen the mix. As soon as the concrete has hardened to prevent damage thereby, it shall be covered with at least 1 in. of wet sand or other satisfactory covering and shall be kept continually wet by sprinkling with water for at least 10 days."

Prevention of Dusting

Another builder of concrete floors wanted to know how floor surfaces could be hardened to prevent dusting, and was advised that "much of the trouble encountered with new floors dusting is caused by delivery of the floor in a dirty condition. Traffic then grinds this dirt into the floor where its presence causes the dust frequently attributed to the floor finish. To remove dirt, the surface should be well swept with a stiff broom, and thoroughly scrubbed with soap-suds. The suds then should be mopped up and the surface flushed with clean warm water and again mopped.

"Under certain conditions it may be advisable to use a hardener treatment on the surface of the floor, although such treatments are not cure-alls for poor workmanship or careless practice. Such compounds as magnesium fluosilicate, sodium silicate, aluminum sulphate, zinc sulphate and various oils, gums, resins and paraffins are used in arresting dusting of defective floor finish. Directions for using these treatments were given in the article, 'Repairing Floor Finish,' published in CONCRETE for November, 1929."

Foundations for Reinforced Concrete First Floor

One concrete builder, who was just beginning to develop the market for concrete residence floors in his locality, was interested in knowing the answer to this question: "When building a concrete first floor in a residence is it necessary to have a heavier foundation to carry the weight of the floor than when a wood joist floor is used?"

"In general," he was told, "heavier foundations or footings are not required with reinforced concrete floors in residences. Either concrete masonry or monolithic concrete foundation walls, as ordinarily built, will support concrete residence floors. Where the floors are supported on a concrete masonry wall, it is customary to fill the core spaces in the top course with concrete to provide a substantial support for the slab and to distribute the weight uniformly to the wall. Concrete floors should have a minimum bearing of 5 in. on the wall."

Use of Floor Paint

In order to meet the demand for special finishes on concrete floors, another contractor was experimenting with paint as a decorative medium. He asked: "How does concrete have to be treated before painting and decorating it?"

He was advised that "before painting concrete, it is necessary to remove all dirt and to neutralize the surface by brushing on a solution of zinc sulphate. The solution, 4 lbs. of zinc sulphate dissolved in 1 gal. of clean water, may be applied with paint brush, mop or squeegee after the concrete has become thoroughly hardened. Before applying paint the surface should be allowed to dry for at least 48 hours and then be brushed to remove zinc sulphate crystals and dust."

Resilient Floor Coverings

Another concrete builder, who was meeting the demand for special surface finishes, wanted information on resilient floor coverings. "When is a concrete floor dry enough," he asked, "for cementing linoleum, cork,* or rubber tile to it?"

The reply was: "The concrete floor must be clean, 'bone-dry' and free from foreign material. A simple test for moisture in concrete may be made by placing pieces of linoleum face down on the floor—one at each corner of the room and another near the center, weighting the edges. After about 24 hours remove the weights and linoleum. If the concrete is not entirely dry, the face of the linoleum and the floor itself will appear slightly damp."

---

*See also the May, 1930, issue of CONCRETE, Page 51.

Reinforcement for Concrete

Reinforcing rods to be used in concrete should be free from scale or excessive rust, as this tends to prevent a close bond between the concrete and the steel reinforcement.

Upsetting an Old Notion About Concrete Floors

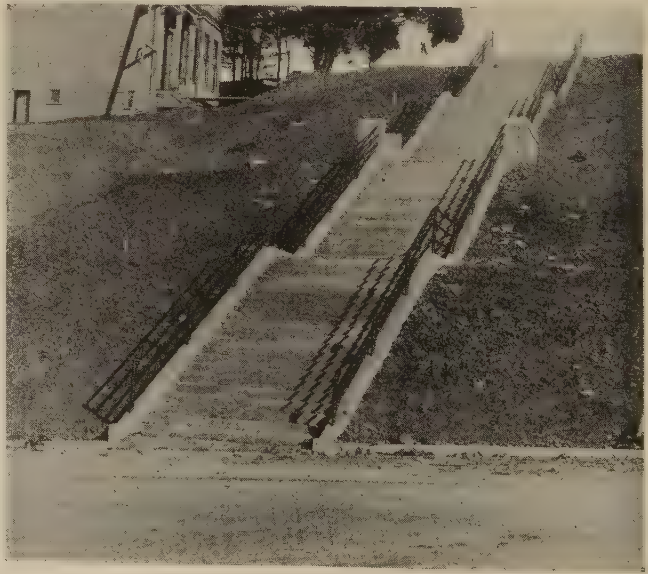
Below are given two paragraphs pertaining to concrete residence floors that concrete builders who are selling concrete for residence construction can incorporate in their sales talks, in their sales letters, in their advertisements or in any printed matter they may issue from time to time. The items follow:

1. Honest evidence is eliminating the old notion that concrete floors above the basement are unbeautiful, cold and damp. The facts are, as architects attest, that a concrete first floor for a residence is, first of all, a definite guarantee of fire safety. This is exceedingly important when fire statistics indicate that a large proportion of house fires originate in basements. If the first floor is of concrete, the fire is stopped. Again, a concrete residence floor ties the whole structure of the house firmly together, preventing the sagging and warping of walls and floors, with their attendant troubles. And a concrete floor is neither cold nor damp. For, while water is used in making of concrete, it enters into chemical combination with the other ingredients. The finished concrete floor is exactly as warm and dry as the air above and below it.

2. The concrete floor has possibilities for decoration which are of immense value to the man who would have his home beautiful as well as strong and safe. The finest hardwood floors can be nailed to wooden strips embedded in the concrete where a wood surface is desired. Linoleum, rubber or cork tile flooring, or ceramics or concrete tile are frequently laid over the base flooring in many rooms. The concrete floor itself has many potentialities. The surface coat can be marked off into squares or any other patterns to resemble tiling, stained in tones of dark red, green or brown and subsequently treated with oil and filler. When waxed and polished, the floor assumes the effect of old Spanish leather and provides an unsurpassed background for fine rugs and furniture.

Stairways in 'Frisco

The accompanying photo shows one of the concrete stairways found in San Francisco, Calif., where the topography necessitates their use in numerous locations.



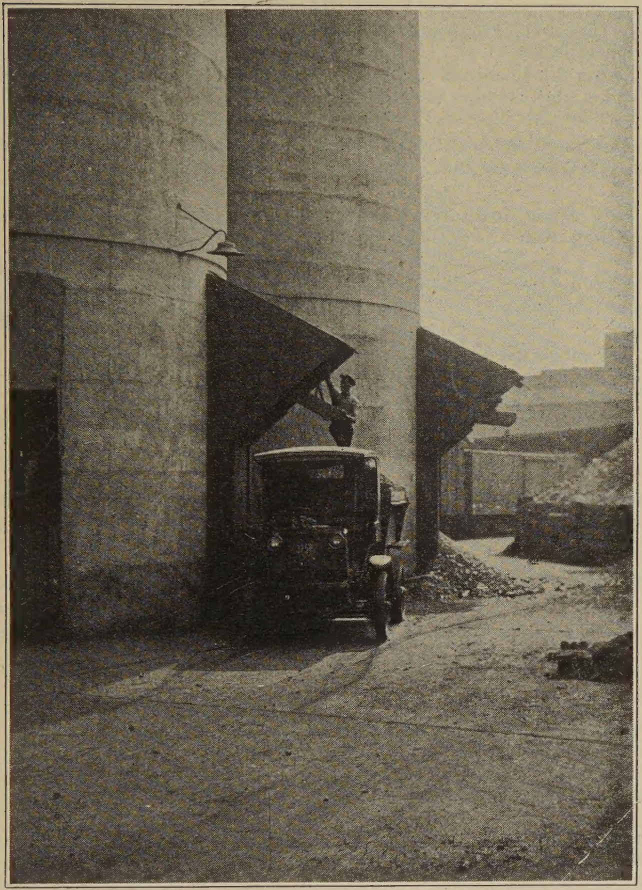
In some cases a concrete drain alongside the steps prevents their being washed out by heavy water.

Coal Dealers Need Concrete Driveways

That the retail coal business offers a good market for concrete work, construction of the kind the average concrete builder can do, is evidenced by the following statement made recently in one of the retail coal publications:

"Then there is the waste of fuel in yards that are not paved. A neighbor competitor, after conducting a coal business for thirty-five years, found an accumulation of four and one-half feet of coal, wood blocks, screenings and dirt.

"Personally, I am of the opinion that one cannot afford to do a coal business without a paved yard, or at least one that has a solid foundation on which to work. There are many instances where the loss in one year has reached from $800 to $3,000 for this item alone. In my judgment the most expensive material with which to pave a coal yard is crushed coal and coke."



On the other hand, the most economical material for paving a coal yard is concrete. Coal dealers everywhere are investing in concrete driveways, paving the way for new business for the concrete builder. One of the largest coal companies in Chicago is now paving all its yards with concrete as rapidly as possible. This company handles an enormous tonnage and knows that a large saving is effected by replacing its former plank driveways with permanent concrete. Dealers in other large cities and small towns as well can be shown the economy of concrete-paved driveways over which to move their loads.

In selling the coal yard market, the concrete contractor can show the dealers that much time is lost and that costs run high when an unpaved yard is hub-deep in mud. With a dependable concrete pavement, however, the dealer is never delayed in getting to and from his bins and cars no matter what the weather may be. Likewise, freight cars are speedily unloaded and promptly released. Concrete-paved yards also invite business and the dealer gains and retains customers who appreciate prompt, satisfactory service.

The market for concrete-paved coal yards can be developed into profitable business by the aggressive concrete contractor.

Overcoming Dusting of Concrete Floors

In practically every case where trouble is experienced with dusting in a concrete floor, an examination will show that the concrete surface was not properly cleaned before being put into use. Immediately after the concrete floor finish is given its final troweling or floating, the surface is entirely free from all dirt. If the floor could be turned over to the owner in this condition, there would rarely be any trouble with dusting.

Most floors which dust have never been properly cleaned after the construction period. Unfortunately, after the floor is finished, it is frequently littered with building debris such as plaster, mortar, concrete, sand, lime and other waste, all of which are driven into the smooth surface. This crust often becomes so ingrained and adheres so tenaciously that it can not be removed by sweeping. It is this dirt that frequently causes unfavorable criticism of new concrete floor finishes which develop dust.

Dust from Coating of Debris

During the first few months of service, traffic is carried on the film of quick-wearing dirt rather than on the real wearing surface. Even light foot traffic will remove this soft film and it will be tracked about or dispersed in the air. This dusting will continue until the dirt has all worn off and the true finish is exposed. In the meantime, the owner may get a false impression regarding the concrete finish. He naturally attributes the dusting to the wearing surface when, as a matter of fact, it is due to the rubbing off of the ingrained dirt.

Completed Floor Must be Cleaned

Regardless of what type of surface treatment is applied to the floor, it always should be thoroughly cleaned by several sweepings with a broom, followed by two or three moppings with soap and water. Unless the floor is particularly dirty these methods generally will be sufficient; but sometimes, in cases where the dirt film is especially difficult to remove, it is necessary to use mechanical rubbing machines.

Covering for Newly Concreted Floor

It is obvious that it would be far more economical and satisfactory for the contractor to take special precautions to protect the floor from the dirt and dust resulting from subsequent building operations. A non-staining paper covered with sawdust or sand is an excellent means of protection.

The application of a hardener treatment or a filler before waxing is not altogether necessary, but is a very good method of increasing the density of the surface layer of concrete, which is a desirable feature for either liquid or paste wax treatments. The use of electrically operated rotary polishing machines will produce better results than hand methods.

The surface density may be greatly increased by troweling the concrete surface after it has lost enough of its plasticity to prevent the drawing of an excessive amount of fine material to the surface. The so-called "hard troweling" is the most effective means of obtaining a dense surface.

The Concrete Industry
—25 YEARS AGO

"PORTLAND CEMENT CONCRETE CONSTRUCTION" is the title of the first article in the June, 1905, issue of Concrete. This is a four-page discussion by Herbert R. White telling of the history of portland cement up to that date, the reinforcement of concrete, protection from corrosion, mixing of concrete and its fireproof qualities.

* * *

A BRIEF article entitled "Influence of Reinforcement Upon Concrete" pays tribute to M. Considere's theory of reinforcement, as follows: "To M. Considere is due a large amount of credit for the extensive research and experiments which he has carried on with reinforced concrete. . . .

"Some who have not yet accepted M. Considere's theory of induced elasticity to concrete by means of steel rods embedded therein have criticized him because his experiments were confined to the laboratory and were not taken from actual construction. There is in our opinion no basis for this criticism, as it would have been impossible to have conducted the large number of tests upon girders of the size usually employed in a building."

* * *

"CONCRETE FORMULA FOR CHICAGO CITY WORK" tells about concrete formula adopted by the City of Chicago for municipal work. It states: ". . . for the river piers, tail pits and anchor piers of its numerous bridges the City of Chicago has adopted a concrete formula which crucial tests have shown to meet every requirement from the water-resisting standpoint, as well as those of sustaining qualities. The formula consists of one part of cement, three parts of sand or crushed stone screenings and five parts of crushed limestone."

* * *

ONE of the articles in "Cement Age" for June, 1905, describes "Concrete Slabs for Roofs." Their manufacture is described as follows: "Wooden forms are used of a size to mold a slab 9½ by 4 by 3½ ft. thick. A layer of neat cement, one-half inch thick, is first laid on the bottom of the form.

"Upon this layer is spread a sheet of expanded metal with ends protruding 2 in. beyond the form. The forms are made in two parts in order to permit of the reinforcing projecting beyond the slab proper. Rich concrete, 1:2:3, is then dumped in from wheelbarrows, which are trundled directly over the forms."

* * *

CONCRETE received the indorsement of the International Railway Congress, according to a report.

The brief item states, "Reinforced concrete has received many and important applications on railroads, both from the technical and economical points of view; it can fully and successfully compete with masonry and timber or steel construction.

"Railroad practice shows that carefully built reinforced concrete structures give excellent service and require almost no maintenance. For this reason the use of reinforced concrete should be recommended, even if the cost of construction should occasionally be higher than for another system of construction."

Organizations

American Concrete Institute; Harvey Whipple, Secretary, 2970 West Grand Blvd., Detroit, Michigan.

American Concrete Pipe Association; M. W. Loving, Secretary, 33 W. Grand Ave., Chicago.

American Road Builders' Association; Chas. Upham, Engineer-Director, 914 National Press Building, Washington, D. C.

American Society of Civil Engineers; Geo. T. Seabury, Secretary, 33 W. Thirty-ninth St., New York City.

American Society for Testing Materials; C. L. Warwick, Secretary-Treasurer, Engineers' Club Building, 1315 Spruce St., Philadelphia, Pa.

Thirty-third annual meeting, June 23rd-27th, Chalfonte and Haddon Hall hotels, Atlantic City, N. J.

Associated General Contractors of America; C. S. Embrey, Secretary, 1150 Munsey Bldg., Washington, D. C.

Cast Stone Institute; L. A. Falco, Secretary, Chapel St. and Blatchley Ave., New Haven, Conn.

Building Officials Conference of America; Col. John W. Oehmann, Secretary, 1253 Lawrence St., N. E., Washington, D. C.

Cement Institute; Luther G. McConnell, General Manager, 11 East 44th St., New York City.

Concrete Masonry Association; Jack Franklin, Secretary, 425 East Water Street, Milwaukee, Wisconsin.

Concrete Reinforcing Steel Institute; M. A. Beeman, Secretary, Tribune Tower, Chicago.

Haydite Manufacturers' Association; Dan F. Servey, Secretary-Treasurer, 203 Mutual Building, Kansas City, Mo.

Iowa Concrete Products Association; R. L. Gavin, Secretary-Treasurer, 1002 Hubbell Bldg., Des Moines, Iowa.

National Board of Fire Underwriters; W. E. Mallalieu, General Manager, 85 John St., New York City.

National Concrete Burial Vault Association; J. H. Stuart, Secretary-Treasurer, Bremen, Ohio.

National Crushed Stone Association; J. R. Boyd, Secretary, 751 Earle Building, Washington, D. C.

National Fire Protection Association; Franklin H. Wentworth, Secretary, 40 Central St., Boston, Mass.

National Lime Association; Norman G. Hough, Secretary and Manager, 927 Fifteenth St., N. W., Washington, D. C.

National Sand and Gravel Association; V. P. Ahearn, Executive Secretary, 432 Munsey Building, Washington, D. C.

National Slag Association; H. J. Love, Secretary-Treasurer, 937 Leader Building, Cleveland, Ohio.

Northwest Concrete Products Association; W. P. Hews, Secretary-Treasurer, Yakima, Wash.

Ohio Concrete Products Association; G. M. Friel, Secretary-Treasurer, 2284 North High St., Columbus, Ohio.

Portland Cement Association; William M. Kinney, General Manager, 33 W. Grand Ave., Chicago.

Rail Steel Bar Association; H. P. Bigler, Engineering Secretary, Builders' Building, 228 N. La Salle St., Chicago, Ill.

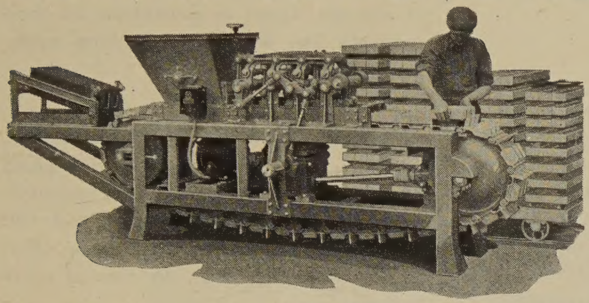
Wisconsin Concrete Products Association; Jack Franklin, Secretary-Treasurer,3115 Plankinton Arcade, Milwaukee, Wisconsin.

New Equipment and Materials

Dunbrik Machine Embodies Line Production

The W. E. Dunn Manufacturing Company, Holland, Mich., has announced the marketing of its new Dunbrik machine, incorporating the modern mechanical method and principle of line production. The manufacturers claim a capacity of 25,000 standard size brick per day.

The brick produced is of the "frogged" type, having a recess on the flat side, requiring 20 per cent less material and producing a unit one-fifth lighter in weight than the ordinary shape, it is said. The advantages of this brick are pointed out as follows: Easier for the brick mason to lay; an improved keyed, mortar bond for the purchaser, and less material with resultant lowered costs of production for the manufacturer.



With this new Dunbrik machine the product is made with any desired water content, approved by engineering standards, and is densely and uniformly tamped, with sides troweled, in its continuous line of travel through the machine, the manufacturer states.

The manufacturing process is as follows: Mixed concrete is placed in the hopper and from this point on the machine becomes automatic, with the exception of removing the finished product, three at a time on a steel pallet, and racking them up. Pallets are automatically fed into the endless chain of molding compartments.

Figures taken from an actual producing plant, the manufacturers state, show that common brick are produced for less than $7.00 per thousand, under ordinary working conditions.

Novo Pump Embodies New Design and Performance

The Novo Engine Company, Lansing, Michigan, makes announcement that it has designed, tested and put on the market a pump that is "entirely new in principle, design and performance."

This pump is known as the Roller Ring plunger pump. One of its main features is that it is said to do away with the changing of diaphragms, packing of pistons, etc., for it has no diaphragms, no packing or oil seal.

Capacity is placed at 3500 to 5000 gallons per hour with a head of 100 ft.

Ingersoll-Rand Makes New Bench-Type Pedestal Grinder

Ingersoll-Rand Co., New York City, announces a bench-type pedestal grinder, known as the Type 9, which can be bolted to a bench or a portable air compressor.

The flow of air to the motor is controlled by a hand-operated globe valve. The machine has a free speed of 3000 r.p.m. and is designed to take a vitrified grinding wheel 6 to 8 in. in diameter with ½ in. face.

Another new unit is an air-motor-driven pump, known as the "ACV." The pump is a Cameron single-stage, single-suction, open-impeller, volute type and is driven by a four-cylinder air motor.

The capacity of the pump, with 60 lbs. air pressure, at 1000 r.p.m., is 130 g.p.m. against a 29-ft. head. With 80 lbs. air pressure at 1200 r.p.m., the capacity is 125 g.p.m. against a 43-ft. head. These figures are based on a 20-ft. suction lift.

Crescent Pipe Machine Features Speed and Economy

Fast production of pipe that meets every specification is the feature of the Crescent pipe machine being marketed by the R. & L. Concrete Machinery Co., Kendallville, Ind.

According to the manufacturer, two outer forms and one core of any kind will keep the machine in continuous operation. Pipe sizes of from 12 to 36 in. in 3 or 4 ft. lengths are produced, and every size may be made with any type end.

Some of the other features pointed out are the speed of production, "the new speed and reduction of labor making old cost records obsolete," reinforcing of the bells, and economy of running the machine, one 5 h.p. and one 3 h.p. motor being required.

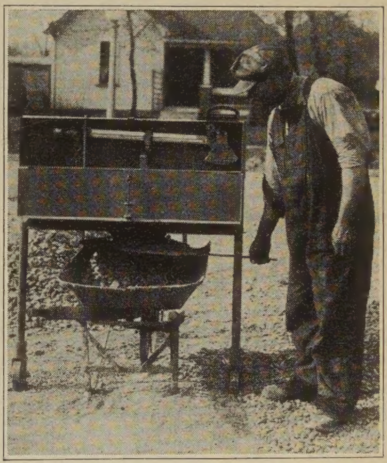
H. W. Remington, New York City, is the eastern and foreign representative.

Johnson Bantam Batcher for Wheelbarrow Batching

The Johnson Bantam weigh batcher, for wheelbarrow batching of accurate weighed aggregates, is designed for building, culvert, small bridge, and curb and gutter work where the job does not justify the setting up of a complete bin and batching unit.

The discharge is a sliding gate high enough for any standard wheelbarrow. The hopper is round, free from any obstructions that might allow the materials to build up—and only the material directly in it affects the weight, according to the manufacturer.

The feature of the Bantam batcher is the weighing unit—the Johnson weigh. Scale parts are entirely of bronze. The beam balance indicator, warning the operator of approaching balance, balance, and overload, can be read from either side—all that is necessary is to set the beam for the desired weight—run the wheelbarrow under the discharge, and shovel into the hopper until the beam balance indicator shows a balance, according to the manufacturer. There are no springs.



Clerseal Is New Colorless Waterproofing

A new colorless exterior waterproofing manufactured by the Adensite Company, New York City, is known as Clerseal. It is said to be effective in preventing efflorescence.

Clerseal is applied with a brush or spray, in two applications, the first following the second in not more than ten minutes. For treating a wall that is effloresced, the masonry is first cleaned and allowed to dry thoroughly before the product is applied. One gallon covers 80 to 100 sq. ft. in two applications, it is said.

About Makers of Equipment and Materials

Industrial Literature

On Wire Fabric Reinforcement

"Reasons for Wire Fabric Reinforcement in Roads and Pavements" is a 20-page publication analyzing the results of experiment and research on the use of the reinforcement. Quotations from engineers and designers support statements made.

This is one of the publications recently issued by the *American Steel and Wire Company*, Chicago.

Ten reasons for using the reinforcement are enumerated, a page being devoted to each. Wire fabric reinforcement, it is stated, provides resistance to cracking due to shrinkage of concrete during setting period, provides tensile strength necessary to resist subgrade friction resulting from changes in temperature or moisture content in the slab, and provides increased resistance to cracking in concrete slabs created by expansion and contraction of subgrades. These and other factors are dealt with.

Reinforcing of runways and taxiways in airport construction is an additional subject treated.

Mixed-in-Transit Concrete

A new addition to the literature on central mixing plants is *Bulletin* 180 of the *Butler Bin Company*, Waukesha, Wis., and entitled *"Butler Commercial Concrete Plants for Mixed-in-Transit Method."*

This is just off the press. Different types of portable and temporary plants, as well as parts, are described and shown in photographs. Layouts in cross section are given for plants varying in size.

Motor Truck House Organ

"Traffic News" is a monthly magazine published by the *Federal Motor Truck Company*, Detroit, Michigan, in the interest of profitable motor truck transportation. The April issue contains an article on motor truck taxation and on other subjects covering uses of motor trucks in different industries.

Besser Facilities and Equipment

A new and attractive publication in which *"Besser Complete Line of Concrete Products Machinery and Equipment,"* as well as the Besser manufacturing facilities and engineering service are described and illustrated has just been issued by the *Besser Manufacturing Company*, Alpena, Mich. Views of the factory are included.

How to Paint Concrete

"How to Paint Concrete and Masonry Surfaces" is a 20-page book, size 8½ by 11, that deals with the successful painting of concrete and masonry with Medusa portland cement paint.

The book enters into the cause of many paints spawling, peeling and chipping off of masonry walls and tells the type of paint to use to overcome these difficulties. The Medusa method of painting wet walls is explained and the reader is given instructions for painting masonry and concrete walls to make them dampproof.

Tramrail Use

The use of the Cleveland tramrail in storing, weighing and shipping of materials or product in tote boxes is suggested in the current 4-page folder of the *Cleveland Electric Tramrail division* of the *Cleveland Crane and Engineering Company*, Wickliffe, Ohio.

New Inspection Bureau

The Material and Equipment Inspection Bureau, newly organized inspecting and purchasing engineers, Chicago, Illinois, have prepared an outline of the purpose and service of the firm. It is addressed to executives, engineers and fiscal agents, and tells its story briefly and concisely.

Duntex Roofing Tile Manual

A comprehensive, excellently color-illustrated publication—the *Duntex Survey and Manufacturers Manual*—has just been published by the *W. E. Dunn Manufacturing Company*, Holland, Michigan, "for the guidance of the Duntex Manufacturer."

Cylinder Testing Paper

"Present State of Cylinder Testing" is the title of a paper presented at a recent meeting of the Compressed Gas Manufacturers Association and made available in booklet form by the *Robert W. Hunt Company, Chicago.*

Motor Truck Field

Commercial applications of motor trucks and developments in the field comprise the bulk of material contained in *"Progress in Transportation"* published by *Reo Motor Car Company*, Lansing, Mich.

"Consolidated Contact"

"Consolidated Contact," the house organ of the *Consolidated Concrete Machinery Company*, Adrian, Michigan, for May contains items on spring selling of ornamental concrete, production of 1500 blocks per man per day, and numerous others.

Notes from the Field

Chain Belt Distributors

The Chain Belt Company, Milwaukee, Wis., announce the appointment of the *J. D. Adams Manufacturing Co.*, Indianapolis, Ind., as exclusive distributors in the Indianapolis territory for their new champion Rex paver and its companion, the Rex road pump.

They have also recently announced the appointment of the *R. B. Everett Company* of Houston, Texas, as distributors for their complete line of Rex construction equipment.

Transit Mixers Chief Engineer

Francis H. James has recently joined forces with *Transit Mixers, Inc.*, manufacturers of Paris Transit mixers, and will make his headquarters at the home office in San Francisco, with the title of chief engineer.

Representatives

The Heltzel Steel Form & Iron Company announces the appointment of the following representatives: *Raleigh Tractor & Equipment Co.*, Raleigh, North Carolina; *Lombard Iron Works & Supply Co.*, Augusta, Georgia; *Gorman L. Burnett, Inc.*, Lynchburg, Va.; *Dravo Equipment Co.*, Pittsburgh, Pa.; *Dravo Equipment Co.*, Cleveland, Ohio.

Kerament Rights

The American Kerament Corp., New York City, has acquired, by purchase, full ownership of all rights of the *Kerament* (Keramic-Cement) process for the United States. This process, perfected in Germany shortly after the war and used since then throughout continental Europe, permits, in a simple and inexpensive way, the production of permanently glazed units of concrete and like products that resemble and are equally as durable as fine faience and similar glazes, according to the announcement.

Concrete Steel Moves

The Concrete Steel Company has announced the removal of its New York offices to 2 Park Avenue.

Dienhart Pottsco Sales Engineer

E. W. Dienhart has been appointed sales engineer for the *H. H. Potts Company*, with headquarters at Chicago, Ill.